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Pronghorn Antelope in Saskatchewan

Status and Management Strategies

Wildlife Technical Report 92-2

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by

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Prologue

Pronghorn Antelope in Saskatchewan: Status and Management Strategies was published in 1992, however, information contained within this technical report was based on data collected up to and including 1990. Although two years separated the data gathering and analysis from the publication date, we feel the recommended management objectives and strategies contained within still remain current.

A number of proposals outlined in earlier drafts were adopted as antelope management goals in 1991. Ratification of other objectives and strategies, or modifications thereof, continued in 1992. The following table briefly lists the objectives and strategies found within the technical report (**PAMP**) and action taken on these recommendations in 1991 and 1992. A more complete description of objectives and strategies may be found on page 53 of this report.

I. Population and Harvest

PAMP Objective	Action Taken 1991	Action Taken 1992
• Strive for provincial post-season population of 15,000 animals.	Objective adopted.	Objective persists.
• Strive for provincial post-season herd structure ratio of approximately 25 bucks to 100 does to 80 kids.	Objective adopted.	Objective persists.
• Manage for population maintenance or growth in areas of range expansion.	Objective adopted.	Objective persists.
• No season or, if population warrants, either-sex seasons in range expansion areas.	Objective adopted; New season in WMZ 18.	Objective persists; New season in WMZ 29; Season closed in WMZ 27 based on wishes of non-consumptive users and stable population.

PAMP Strategy	Action Taken 1991	Action Taken 1992
• Create a non-trophy season.	Season established.	Season persists.
• Non-trophy definition: "A female or male having horns not more than 7.6 cm in length".	Definition adopted.	Definition modified: "Doe or Fawn, only".
• Either-sex licence holder may also hold non-trophy licence.	Strategy adopted.	Strategy persists.
• Hunter may purchase up to 3 non-trophy licences.	Modified: 2 licence maximum; 3 thought to be excessive.	2 licence maximum persists; 3 thought to be excessive.

• Price per non-trophy licence $20.00	Strategy adopted: Price $20.00.	Strategy persists: Price $20.00.
• Either-sex and non-trophy season dates coincide.	Modified: Total overlap of primitive weapons seasons; non-trophy rifle commences 3 days after start of either-sex rifle season.	Modification persists: Non-trophy rifle commences 3 days after start of either-sex rifle season.
• Non-trophy antelope coincide with mule deer and white-tailed deer seasons.	Modified: Season overlap with either-sex and non-trophy mule deer seasons.	Strategy adopted: Total overlap of all mule deer and white-tailed deer seasons.
• Delay non-trophy antelope licence sales until after the Big Game Draw.	Modified: Licences available in initial Draw, Supplemental Draw (conducted due to poor sales) and at department offices (licences still remained after Supplemental).	Modified: Non-trophy antelope no longer a Draw licence; sold by department offices and private vendors after results of Draw are known.
• Use telephone draw system to sell licences; surplus licences sold at department offices.	Telephone not adopted - too expensive; surplus licences sold at department offices.	Modified: Non-trophy antelope no longer a Draw licence; sold by department offices and private vendors.
• No priority pool for non-trophy licences - random selection every year.	Strategy adopted.	Strategy persists.

II. Population Monitoring

PAMP Objective	Action Taken 1991	Action Taken 1992
• Precise, cost-effective population monitoring.	Objective adopted: Data collection techniques restructured to meet objective.	Objective persists.

PAMP Strategy	Action Taken 1991	Action Taken 1992
• Management assisted by use of computerized population models.	Strategy adopted: Data now collected in such a fashion appropriate to population modelling.	Strategy persists.
• Population models for each WMZ.	Creation of provincial model; models developed for only 4 WMZs.	No progress on strategy.
• Use of Line Transect as aerial survey technique for estimation of population size.	Strategy adopted.	Strategy persists: 5 Line Transect survey blocks flown.
• Population surveys flown at 3 year intervals in late May-early June.	Strategy adopted.	Modified: 5 blocks flown due to current management needs and lack of population models.
• Herd classification surveys flown annually in September.	Five WMZs flown on September 17 and 18.	Three surveys planned.
• Operate antelope check stations to ascertain population's age structure.	Strategy adopted: Check stations operated, but poor response due to weather.	No check stations planned.
• Department operated check stations in 1991; privately operated in 1993.	Check stations operated at 3 locations, but inadequate number of samples collected due to weather.	No progress on soliciting private operators.

III. Communications

PAMP Objective	Action Taken 1991	Action Taken 1992
• Inform public of change in provincial antelope management.	Objective adopted.	Objective persists.

PAMP Strategy	Action Taken 1991	Action Taken 1992
• Inform hunters of change in antelope management philosophy through department information sources and the press.	Advertised in department hunting publications and press releases.	Advertised in department information sources.
• Publish information pamphlet on antelope management objectives for free distribution to landowners, hunters and non-consumptive users.	No action taken.	No action taken.

In retrospective, we are pleased with the number of PAMP recommendations that were adopted by the department. It is our hope that these ideas will persist or act as cornerstones on which to build future objectives and strategies for pronghorn antelope management in Saskatchewan.

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Abstract

Throughout the middle part of this century the pronghorn antelope (*Antilocapra americana* Ord) population in Saskatchewan remained relatively constant at approximately 8,000 to 12,000 animals. However, over the past 10 years antelope numbers steadily increased due to improved survival through a series of mild winters, hunter selection for bucks and a management philosophy which promoted population growth rather than control.

The 1980's also saw the decline in the economic fortunes of the farmer and rancher due to a series of droughts, poor markets and increased operation costs. Demands from the agricultural community to reduce the antelope population and an ever growing number of depredation claims for government sponsored compensation, were the principal motivators behind the need to develop a long-term management plan for pronghorn antelope. It was intended that this plan would reflect the current demands of the Saskatchewan public.

Current survey methodology was reviewed as to the most precise technique(s) available to measure total population, density and distribution. Every square mile within a survey block was classified into one of five land classes based upon the amount of native habitat remaining within its boundaries. Three aerial census techniques were tested over 16 survey blocks comprising 6,902 km^2. These techniques were trend lines (used in Saskatchewan since 1960), stratified block and Line Transect. Results indicated that the old trend line survey consistently underestimated population size, primarily owing to unobserved animals as distance increased from the aircraft. The trend line versus Line Transect difference in mean population estimates for the entire survey effort varied 59 per cent and ranged for individual survey blocks from 30 to 324 per cent of the estimated means.

When trend line was compared to the stratified block method, it was felt the latter underestimated population sizes although confidence intervals were tighter. In some cases insufficient numbers of a particular land class were flown in the stratified block technique to make statistically valid population estimates ($B = 0.1$; $P \leq 0.05$). It was concluded that Line Transect was the most cost-effective method of those tested, contained fewer observation biases and resulted in population estimates which reflected more closely the true antelope population.

Based on the Line Transect results and extrapolation of densities over the known provincial range, the June, 1990 adult population was calculated to be approximately 24,700 animals.

Antelope selected ($P \leq 0.05$) for lands that contained as much native habitat as was available in the surrounding landscape. In survey blocks which contained primarily native habitats, antelope were observed at a higher rate of occurrence than expected on Class 1 lands (90 to 100% native vegetation), occurred as expected on Class 2 lands (50 to 90% native vegetation) and were observed at a rate less than expected on land classes with more agricultural development (0 to 50% native vegetation). In survey blocks which were comprised of predominately developed agricultural lands, antelope continued to select for land classes which had remnant amounts of native vegetation while avoiding those which were entirely developed.

Antelope which did occur on developed parcels (mi^2 blocks) of land inevitably selected ($P \leq 0.05$) for areas or pockets of native habitat on those blocks. Even on blocks which contained only trace amounts of native habitat, animals were observed at a greater frequency than expected on these trace amounts than on the much larger proportion of developed area.

The socio-economic costs and benefits were examined to ascertain the net worth of the antelope resource to Saskatchewan. Based on 1989 licence sales, antelope hunting contributed 11,000 days of recreation and generated $1.3 million in hunter expenditures. Secondary round of spending was estimated to be more than $0.6 million and created 24.5 person years of employment. However, the current antelope population which generated $2.0 million dollars of economic output has also produced record numbers of crop damage complaints (42) and compensation pay-outs for depredation ($40,000). Landowner displeasure with existing antelope population levels and with the department's past management practise of allowing growth in the herds, was gauged to be at an all time high.

A list of objectives and strategies were developed for the provincial antelope resource and constituted the management plan for this species. Cornerstone to these recommendations will be the acceptance of a much lower provincial population and the adoption of a new hunting strategy (ie. non-trophy antelope seasons). If these, and other objectives and strategies listed in this report, are employed, it is expected the future needs of hunters, landowners, businesses and government will be met under such a plan.

Acknowledgements

The authors are indebted to many individuals who assisted in the completion of this project. Of important note was the contribution made by persons outside of the Wildlife Branch. Harry Harju, Gary L. Fralick, Bruce Johnson and Dan Thiele, all of the Wyoming Game and Fish Department, aided by way of their constructive comments on survey techniques, population modelling and supplying important materials. Similarly, Ray Mule of Montana Fish, Wildlife and Parks and Leo Gudmunson of Alberta Forestry, Lands and Wildlife contributed by relating events and management strategies in their respective jurisdictions. Brian Knudson of Manitoba Natural Resources is extended a special thank you for his advice on statistical analysis.

Saskatchewan Natural Resources (SNR) Operations staff from the Swift Current Region assisted by recommending management proposals and strategies for a non-trophy antelope season. Wally Kost, Biologist and Rod Froc, Forestry Technician also contributed in a similar fashion. A number of other Conservation officers aided Dwight Dobson in identifying herd location and size in the outer most reaches of the antelope range and their contribution is gratefully recognized.

Dave Dalke, Conservation Officer, expertly piloted and navigated the Cessna 185, contributed to antelope observation and provided valuable suggestions on strut marker design and placement. Special thanks to Lorne Sullivan, Conservation Officer, who filled in as one of the observers in the aircraft when normal survey crew members were unavailable.

Within the Wildlife Branch a number of people assisted in the production of the PAMP document. Fred Beek contributed to this project by setting up computer driven data base files, instructing the senior author on their use and by supplying a list of hunters who were to be sampled as to their opinion on a new harvest strategy. Kevin Callele helped produce and

analyze the hunter questionnaire sent to this list of Saskatchewan antelope hunters. Biological assistants Troy Emery and Ted Nokonechny completed the major portion of land classifications. Cam Scheelhaase contributed by reviewing the final text. Finally, we thank Hugh Hunt for initiating this project and his review of the manuscript.

Bruce Weild and Michele Reich are recognized for their contribution in the final production of this document.

A special debt is owed to Brenda Lee Theriault for typing this manuscript while Betty McIntosh, Cathy Davidson, Naomi Richaud, Judy Killaby and Carisma Killaby are acknowledged for inputting the large volume of data into computer files.

The antelope hunters of Saskatchewan who returned survey questionnaires are specially recognized for their contribution to the development of a new harvest strategy. Because of their response, new antelope management initiatives were developed to fit the wishes of the majority of the hunting public.

Finally, special acknowledgement is extended to Richard Guenzel, Wyoming Fish and Game Department, and Gary White, Colorado State University. Rich supplied practical knowledge on flying antelope surveys using line transect methodology, calculated strut band measurements based on our needs and gave constructive tips on the interpretation of analyzed data. Gary supplied practical knowledge on the use of line transects as well as instructing the senior author on the statistical basis for each of the different models created by his Line Transect program. Gary also provided important recommendations on data analysis and interpretation. A sincere thank you, gentlemen.

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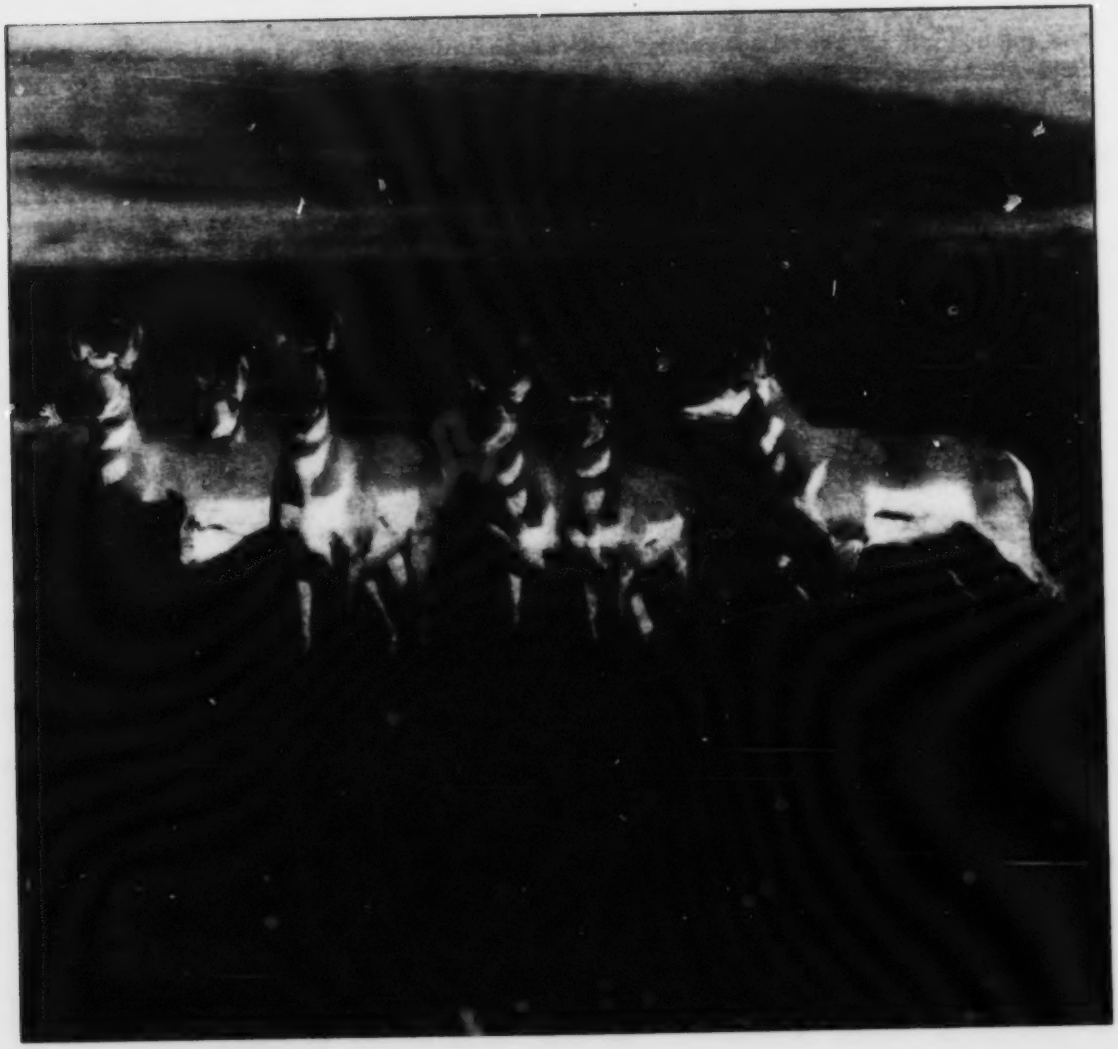
Introduction



Fossil records imply that one of the earliest ancestral forms of the present day pronghorn antelope appeared in North America some 25 million years ago (Romer, 1966 cited by Mitchell, 1980). Throughout the epochs following the Miocene, a variety of intermediate species evolved and then disappeared in response to the many continental upheavals in climate and geological landforms (Mitchell, 1980). Today the North American pronghorn antelope (*Antilocapra americana* Ord) is generally classified as being the only remaining member of an unique family taxa called Antilocapridae, although there has been some debate as to whether or not the pronghorn is actually a distant relative of the Old World antilocprin bovids (O'Gara, 1982).

The pronghorn is commonly recognized as an unique species of the Great Plains (Figure 1). This fleet-of-foot creature was a potential food source for the aboriginal peoples of the prairie ecosystem and is regarded today as an important recreational asset by consumptive and non-consumptive users alike. Early fur traders and settlers harvested these animals to supplement their diets of normally dried meats and cereal grains. During the Great Depression of the 1930's, attempts were made to harvest antelope for "relief" rations which were destined for eastern Canada (Figure 2). Archival information is sketchy as to the rationale behind this policy but it appears this program lasted only one or two years. Low populations and cost effectiveness were probably the reasons for abandonment of this program.

Wildlife historians such as Nelson (1925 cited by Mitchell, 1980) and Seton (1953 cited by Mitchell, 1980) estimated that the North American antelope population was as great, if not greater, than those of the bison prior to European settlement. Approximately 30 to 40 million roamed the Great Plains, yet, were quickly reduced to remnant herds by the end of the 19th century (Figure 1). Indiscriminant market-hunting, the destruction of habitat, the construction of more and more impassable fences, improper livestock grazing practises and a cycle of summer drought and harsh winters all contributed to the demise of the great antelope herds (Dirschl, 1960a; Mitchell, 1980; Pyrah, 1987). Hornaday (1913 cited by Mitchell, 1980) estimated the 1908 Saskatchewan population to number 2,000. Five years later Hornaday revised his estimate downward to 1,500 (Anonymous, 1913; Appendix I). By 1921, almost all hope had vanished for the salvation of free-ranging antelope in Saskatchewan as the estimated population stood at only 200 animals (Anonymous, 1921; Appendix I). In 1913, one unidentified Voluntary Game Guardian summed the situation in this manner:

> "I have not seen any antelope of five years, nor heard of them. I am afraid they are all gone."

Fortunately they were not all gone. The closure of seasons in Saskatchewan, Alberta and Montana (Dood, 1984), as well as a blossoming interest by ranchers in the preservation and protection of this species, resulted in a rejuvenation of provincial herds (Figure 3). By 1936, populations in Saskatchewan had done so well that a short, open season was permitted in which 267 animals were harvested.

Today Saskatchewan still continues to share the benefits of this resource with Alberta and, together, their prairie regions constitutes the northern limits of the pronghorn's contemporary range (Figure 1). Present day population estimates probably favour Alberta, however, distribution is thought to be similar throughout both jurisdictions.

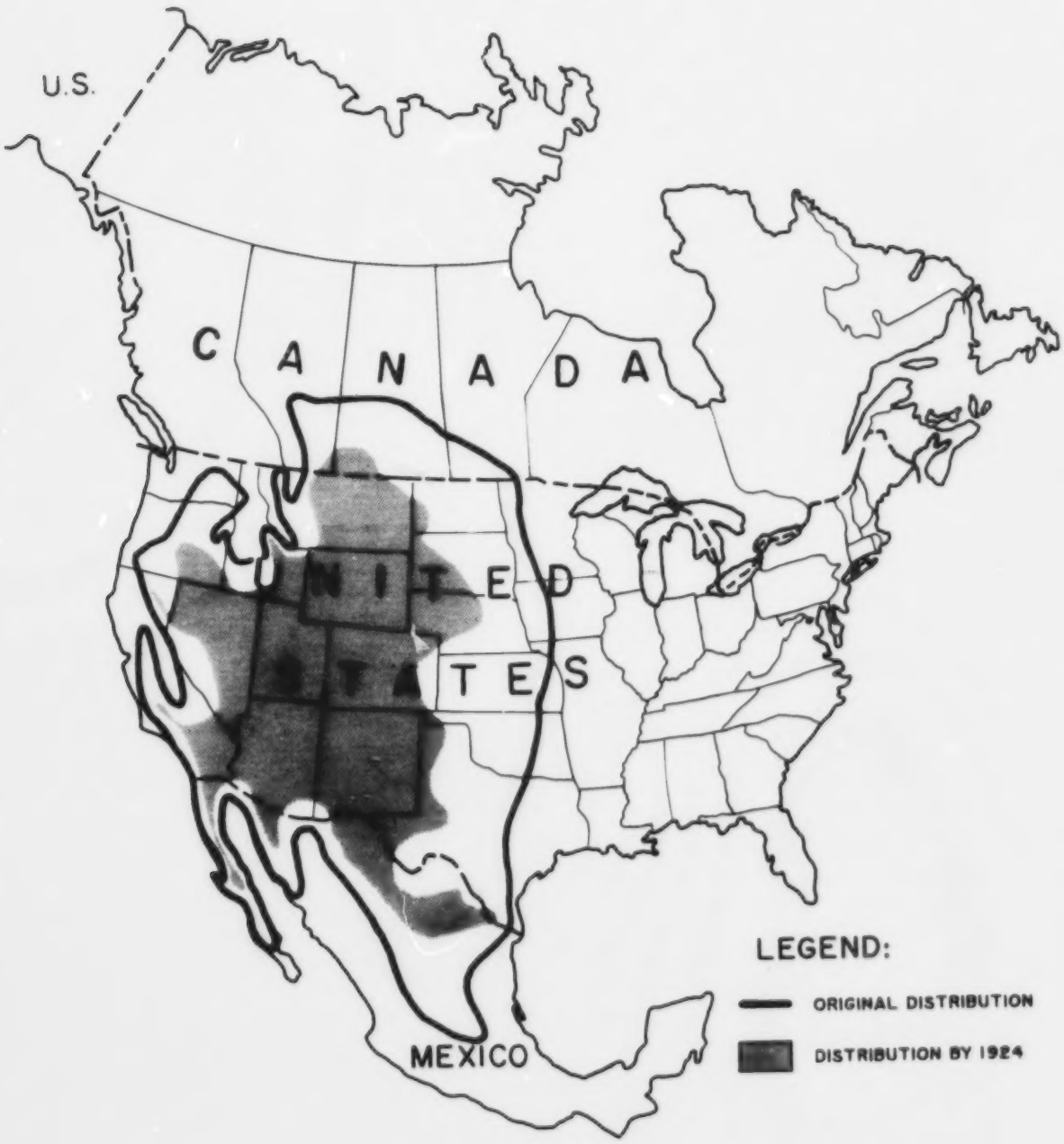


Figure 1. Historic distribution of pronghorn antelope in North America (Nelson, 1925 cited by Hnatiuk, 1976).

Figure 2. Antelope destined for eastern Canada as relief rations (Courtesy Sask. Archives).

Figure 3. Estimated pronghorn antelope population trend.

Prior to the 1980's, antelope populations remained relatively stable, numbering between 8,000 to 12,000 animals (Dirschl et al., 1960-1971; Balez et al., 1972-1980). Population growth was kept in check by our harsh winter conditions (primarily) and by regulated hunting seasons (secondarily). However, the decade of the 1980's saw a change in "normal" winter weather patterns which in turn resulted in a dramatic improvement in survival rates and herd distribution (Figures 3 and 4). Hunting licence allocations were increased to account for growing populations, however, the actual rate of growth was probably underestimated and licence allocations were not sex specific. The adult female segment, along with its reproductive potential, continued to expand.

Simultaneously with the growth of the antelope population came the downward economic fortunes of the Saskatchewan farmer and rancher. A series of droughts in southwestern Saskatchewan, poor markets for agricultural produce, and increasing input costs eroded disposable incomes of most farm residents. Tolerance to losses caused by big game was at an all time low. Demands from the agricultural community to reduce antelope populations and an ever growing number of depredation claims for government sponsored compensation were the principal motivators behind the development of a pronghorn antelope management plan (PAMP).

The PAMP had the following objectives:

1. **To ascertain the present population size and distribution of pronghorn antelope in Saskatchewan.**

2. **To establish a maximum population objective which would accommodate the needs of landowners, hunters and non-consumptive users for the remainder of this century.**

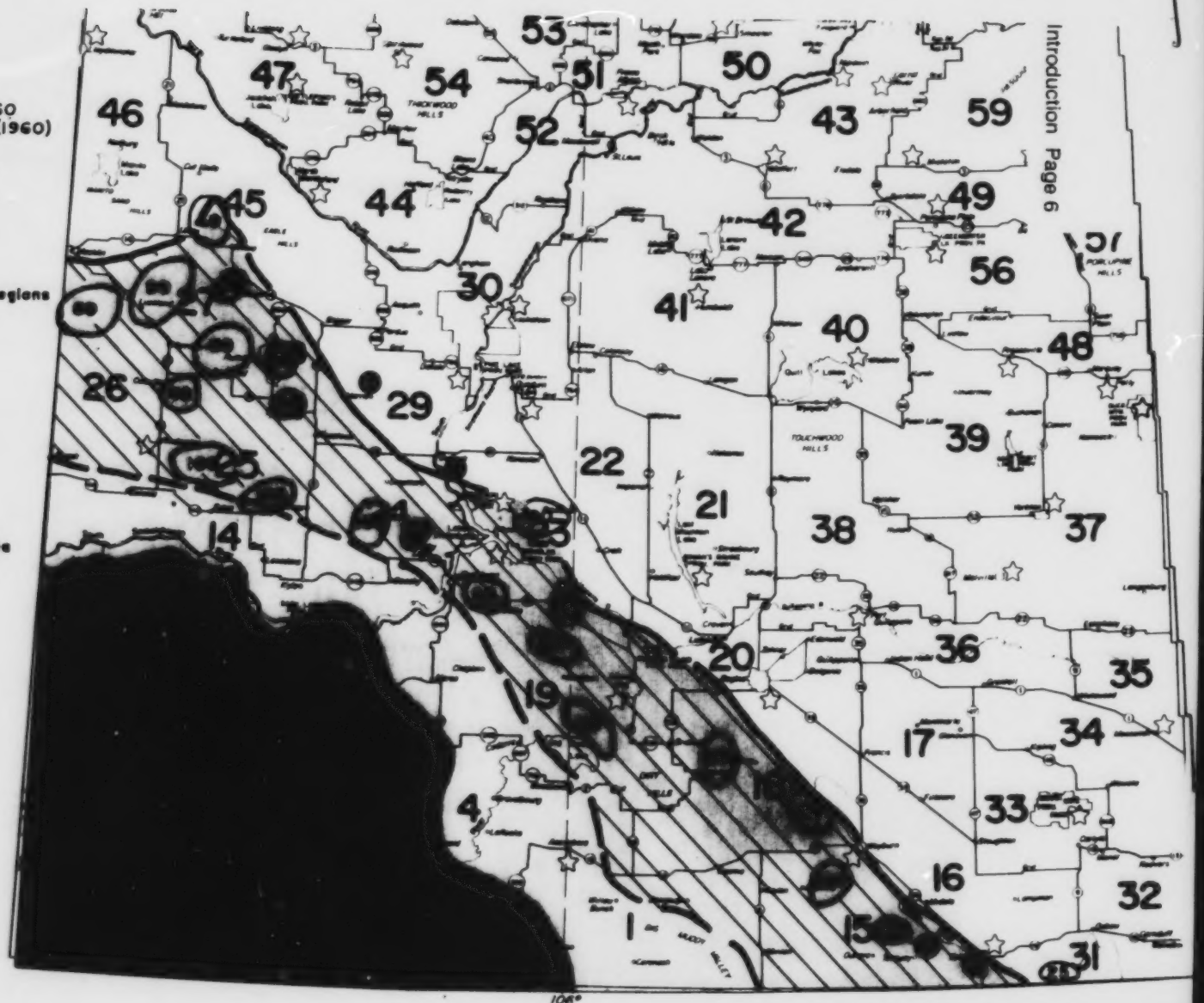


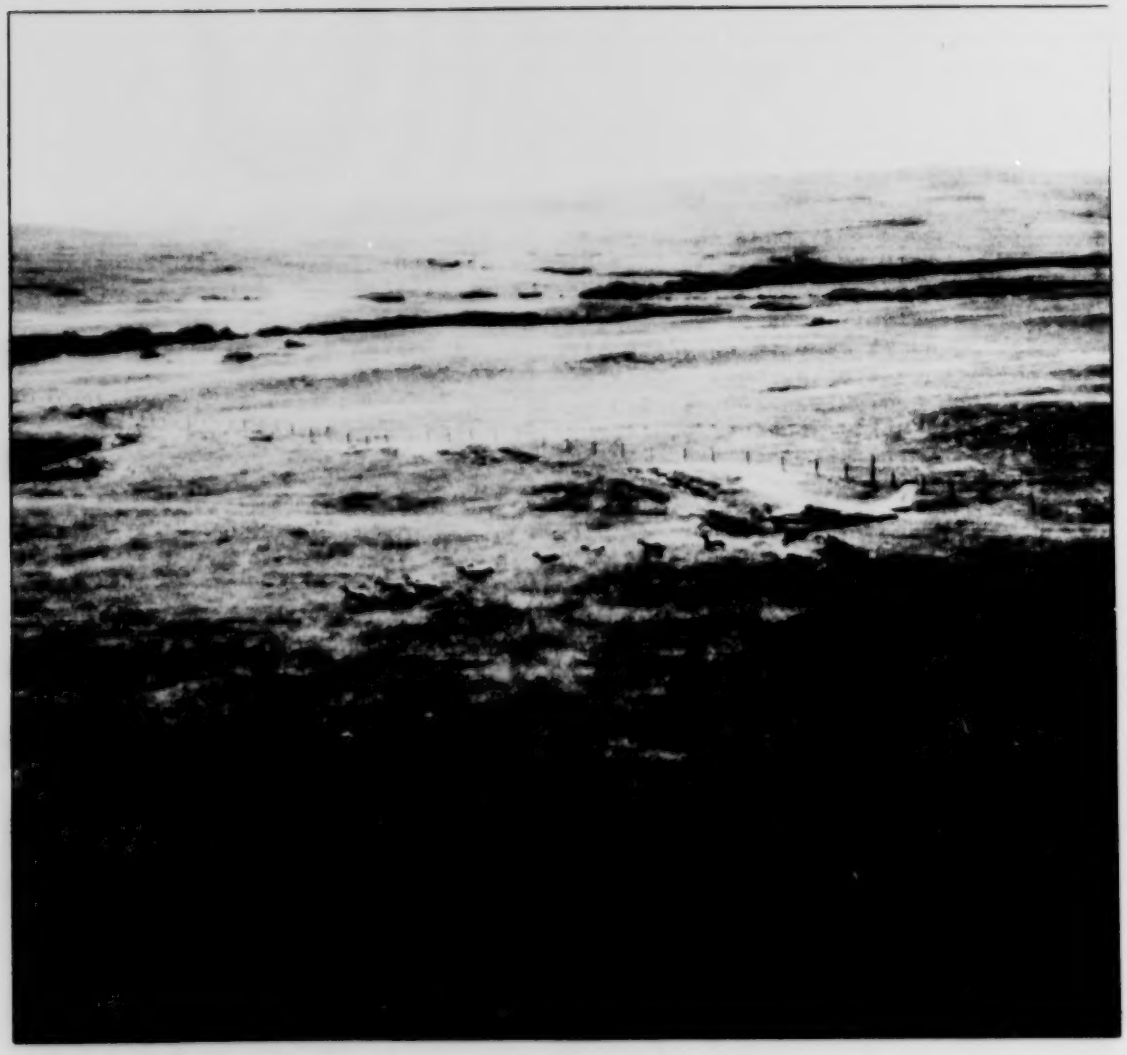
Figure 4. Pronghorn antelope range in Saskatchewan. Density ranges (high, moderate and low) were delineated based on the authors' personal knowledge of antelope concentrations.

3. **To develop a harvest system, within environmental and biological limits, that would achieve the desired population goals in an acceptable period of time and would reflect the wishes of impact groups.**

4. **To develop a precise, yet, cost-efficient monitoring plan for antelope populations in Saskatchewan.**

The management of any wildlife species is subject to many pitfalls. Incorrect decisions are made as a result of poor planning, erroneous information and subjective analysis. It was the authors' intentions that PAMP would help rectify some of these problems and give wildlife managers a sound base on which to make informed decisions. This would in turn benefit the pronghorn antelope resource and reflect the wishes of the Saskatchewan public.

Population Status



Census Techniques

In 1960, Saskatchewan adopted an aerial survey system which monitored antelope population trends and sex/age structures on permanently established blocks. These blocks had changed little since being established by Dirschl (1960b). Surveys were flown late June through to early July in order that the current year's trend and productivity (i.e. fawn per doe ratio) could be ascertained before the department's mid-July administrative deadline to assign seasons and licence quotas within the province.

Methods for estimating pronghorn abundance have often been deficient in that the true population density has been underestimated (Allen and Samuelson, 1982; Firchow et al., 1990; Guenzel, pers. comm.). Trend line methodology has been the standard across North America because of the ease of flying and cost-efficiency. However, it has long been accepted that this method contains an observability bias and are quite variable from year to year limiting its use as an index to population change (Johnson and Lindsay, 1989).

The random block technique has also been evaluated as to its effectiveness in estimating antelope populations. Pojar et al. (1982) and Firchow et al. (1990) found significant differences between strip versus quadrat census methods. Quadrat results consistently over-estimated population sizes and had wide confidence limits, most likely due to introduced biases inherent to random block analysis. For example, wildlife managers find it difficult to accurately quantify antelope preference for different habitat type (ie. stratification). Antelope are extremely mobile creatures, preferring to run from danger (eg. sound of an aircraft) rather than hide, thus creating counting errors due to animals moving off or onto quadrats. Finally, antelope are gregarious animals and are prone to group in herds of varying sizes. This in turn increases variation in count sizes and impacts on the final accuracy and precision of quadrat analysis.

Hnatiuk (1976) converted survey block data into a stratified random sampling technique where each survey block was considered one stratum. He also transformed Dirschl's (1960b) trend line survey into a stratified sample, again each block was treated as one stratum. When the means from both surveys were compared, differences were negligible. Hnatiuk determined that these results substantiated Dirschl's survey methodology and data analysis of Saskatchewan's antelope populations. However, calculated ranges (bounds) were consistently higher for the stratified random sampling method, thus Hnatiuk concluded that this technique was not specific enough to give estimates which detected important population change from year to year.

In 1990, a different survey technique called **Line Transect** (LT) replaced the standard trend line method. LT sampling has been used since the early 1930's for a number of wildlife species (Burnham et al., 1980), but critical development of the technique did not begin until the 1960's. LT had a number of qualities which made it attractive for pronghorn population analysis within Saskatchewan:

1. Existing survey blocks could be duplicated and a comparison made between results obtained by trend line and LT. Duplication of blocks meant that affinity with historic survey results (based on animals observed before LT analysis) would be maintained.

2. LT was no more costly than the existing trend line surveys. In fact LT surveys in high densities areas will be less expensive in future years once the initial testing is completed.

3. LT implicity assumes that not all the animals will be seen as distance from the aircraft increases.

4. Survey biases such as weather and observer experience are constantly in flux, yet, have little effect on the LT estimate.

5. Confidence intervals could be constructed around the estimate, thus providing guidance for a range of management decisions.

6. If LT was found to be reliable, then the technique could be expanded to other parts of the antelope range and a more cost-efficient, but accurate, monitoring program could be developed for antelope across Saskatchewan.

Methods

In 1986, the antelope survey effort (area covered) was dramatically cut by 52 per cent from previous years. Continued budget restraints and other big game survey priorities had meant that only a few key ranges could be monitored from 1986 onward. It was erroneously hoped that the results from these high quality ranges would be indicative of antelope densities and sex/age structures across the province. In order to meet the PAMP's first objective, that is, to ascertain the present population size and distribution, a more extensive survey effort was undertaken to overcome the obvious bias introduced by sampling high quality ranges. Total area surveyed jumped from 1,512 and 1,738 km^2 in 1988 and 1989, respectively to 6,902 km^2 in 1990[1]. Sixteen survey blocks were flown (Figure 5), three of which were new and incorporated more of a mix of native and developed habitat types.

Surveys were conducted between 0600 to 1100 hours or 1600 to 2000 hours from June 4 to 13, inclusive in a Cessna 185 equipped with a radio altimeter. The aircraft was flown at an average elevation of 91.4 meters (300 ft.) above the ground, 30 meters below normal for past trend line surveys in Saskatchewan but equivalent to transect surveys in Wyoming (Johnson and Lindsay, 1989).

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[1]Area figures represent flight line area; not survey block area.

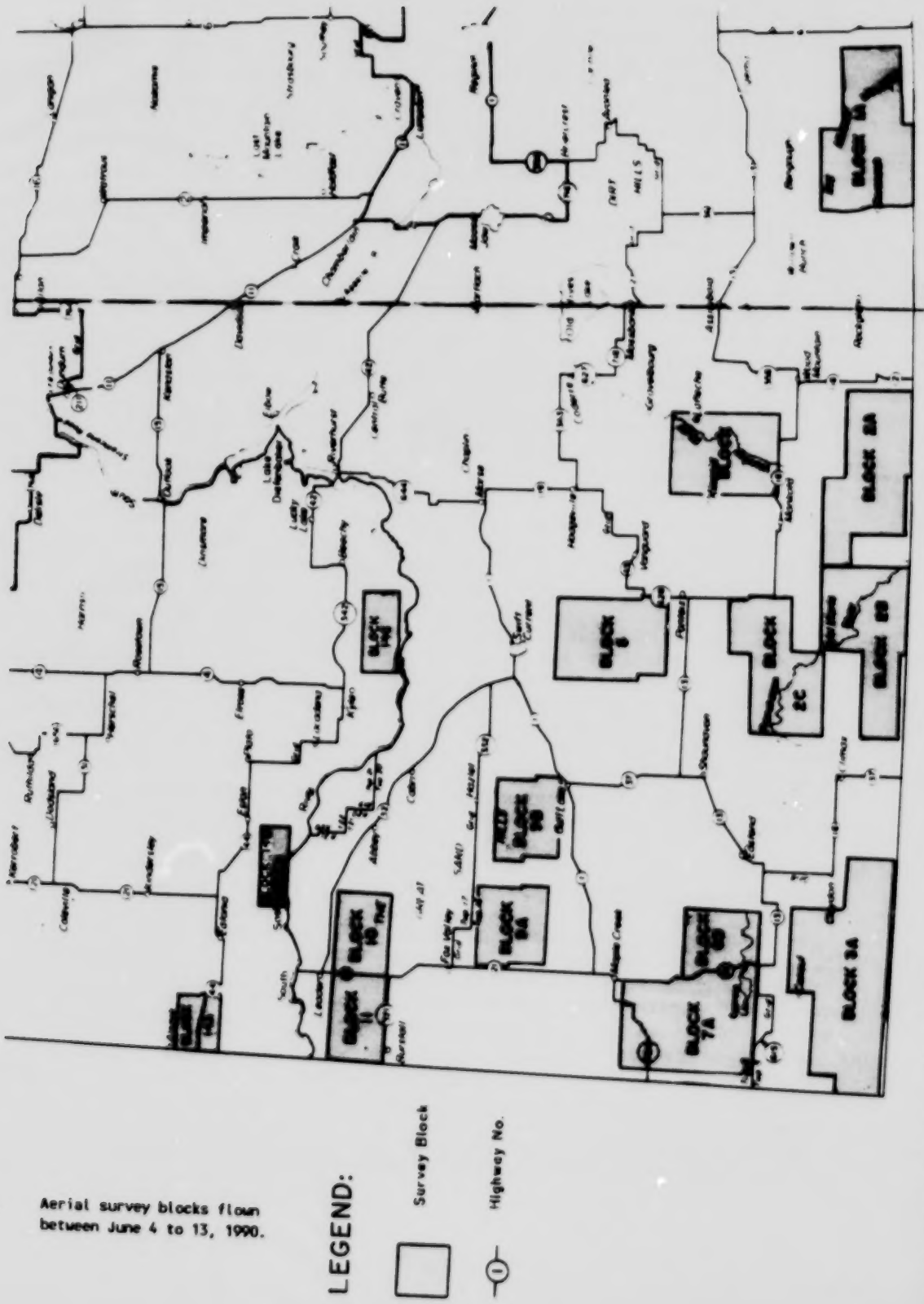

Figure 5. Aerial survey blocks flown between June 4 to 13, 1990.

I. Line Transect

Antelope counts were based on group or cluster counts, that is, regardless of whether there were one or 20 animals together, it was recorded as a count of one. As mentioned, the normal period for trend line surveys were late June - early July. Because the sample unit was a cluster and not individual animals, the earlier LT survey took advantage of the period of time when antelope were most widely distributed - parturition (Mitchell, 1980; Reeves, 1982; Johnson and Lindsay, 1989).

LT requires the accurate placement of pronghorn clusters into distant bands perpendicular to the transect line. For our purposes, desired band widths were determined to be 50 meters (Band A), 50 meters (Band B), 100 meters (Band C), 200 meters (Band D) and 400 meters (Band E) at an average elevation of 91.4 meters (300 feet). The placement of the inner most border for the first distance band (Band A) was 50 meters out from the centre line on either side of the aircraft (Figure 6) because of the observability bias introduced by the fuselage. This area was referred to as the "dead zone" and animals observed in or coming out of this zone into other bands were not counted. Wooden dowels 6.4 millimetres in diameter, approximately 1.5 meters in length and painted black were affixed to the struts on either side of the aircraft (Figure 7). The spacing for the dowels was calculated with the assistance of Richard Guenzel (pers. comm.) In order to obtain the proper band widths on the ground at an elevation of 91.4 meters and with the observers in the back seat of the aircraft, the necessary strut measurements were 41.8 cm (outer edge of "dead zone"), 67.4 cm (outer edge of Band A), 84.7 cm (outer edge of Band B), 106.5 cm (outer edge of Band C), 128.7 cm (outer edge of Band D) and 151.5 cm (outer edge of Band E).

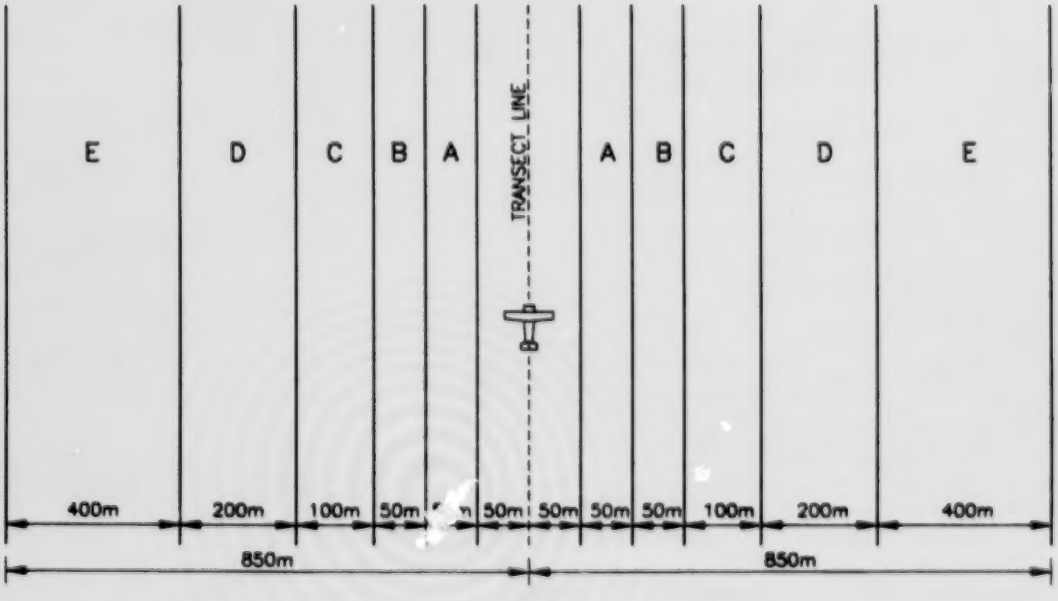

Figure 6. Transect line and distance band spacing on either side of the aircraft at 91.4 metres AGL.

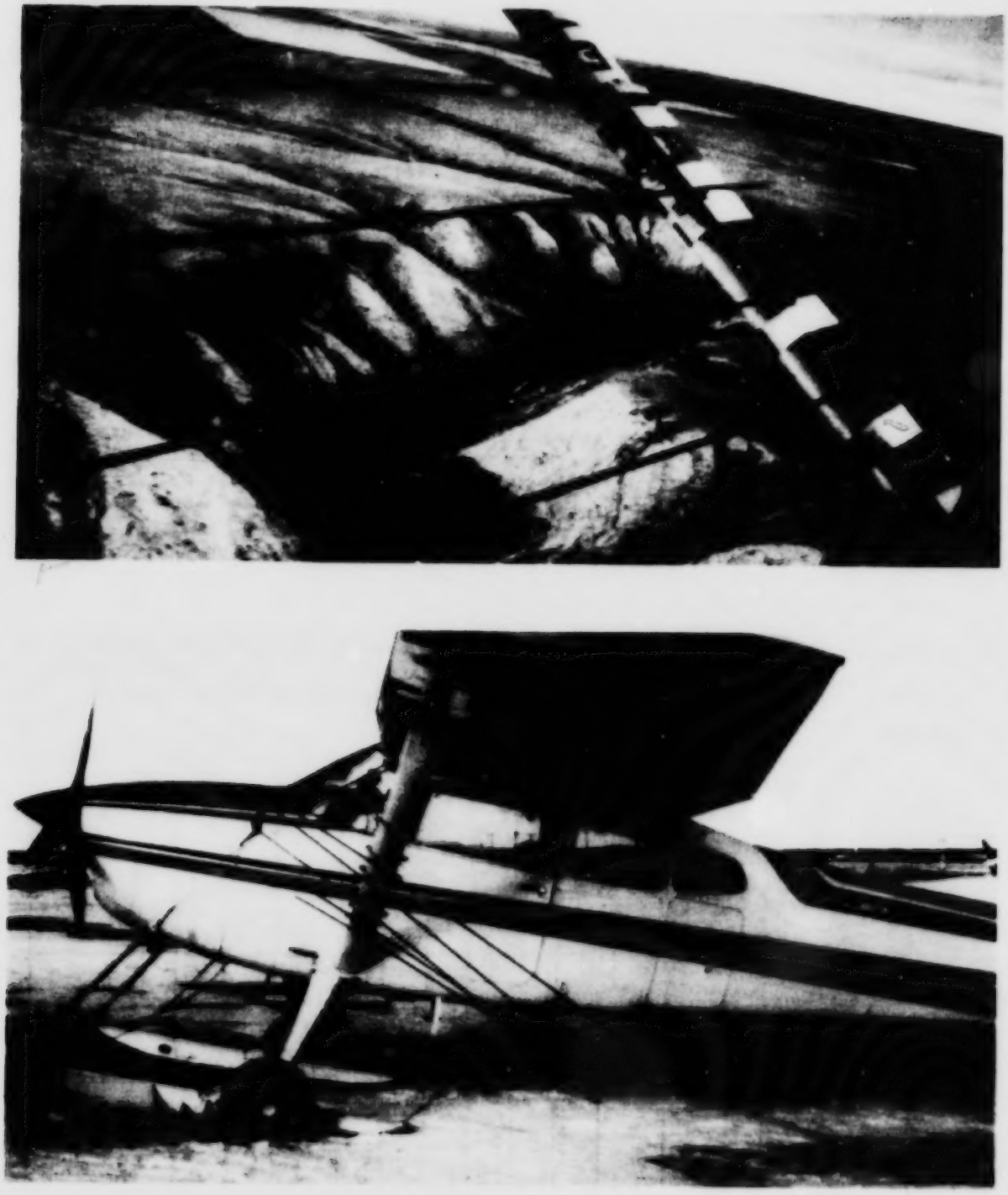

Figure 7. Cessna 185 equipped with line markers.

Transect lines were oriented east-west and set 3.2 kilometres (2 mi.) apart, being generally 29 kilometres (18 mi.) in length. Two observers in the back of the aircraft enumerated antelope groups and antelope per group on either side and determined their position within distant bands perpendicular to the transect line. The pilot was responsible for navigation and maintaining proper elevation while a third observer in the front recorded antelope sightings, change in land classification and altimeter readings.

Survey data was input into the computer program Transect II, version 2.2 (White, 1988). The user can select up to five models which will fit a curve to the data set. These estimators were: Fourier series, Exponential power series, Exponential polynomial series, Negative exponential series and Half-normal series. The models produced different estimates of group density and confidence intervals (P= 0.05), depending on the shape of the histogram for the data set. The model chosen to represent the data set met the following criteria in order of importance:

1. Best fit of the probability density function curve, that is, where the curve intercepts the y-axis.

2. Smallest per cent of coefficient of variation, that is, narrowest confidence intervals.

3. Best Chi-squared goodness of fit test.

After the appropriate model had been selected, the estimate of population size was simply a product of **Density of Groups * Number of Pronghorns per Group * Area.**

II. Stratification of Blocks

Before surveys commenced, each square mile (considered a quadrat) within the survey blocks was classified by way of aerial photographic interpretation as to the amount of native habitat remaining within its borders. Following the surveys, photo interpretation was expanded to include the entire area within Dirschl's (1960a) range map (Figure 4). Land class definitions were:

Class 1: 90 to 100 per cent of the quadrat remains in native habitat.

Class 2: 50 to 90 per cent of the quadrat remains in native habitat.

Class 3: 30 to 50 per cent of the quadrat remains in native habitat.

Class 4: 2 to 30 per cent of the quadrat remains in native habitat.

Class 5: 100 per cent of the quadrat developed; may contain trace amounts of native habitat which constitutes less than 2 per cent of the quadrat's area.

Aerial photomaps, scale 1:20,000 (1979-80) were used in cataloguing land type and their accuracy was checked while the survey was in progress. Quadrats which were incorrectly identified were re-classified and the per cent of change for each land class was recorded. From the classification process, information on the amount of remaining native range, per cent of land class change (ie. native to agricultural development) since 1979-80, and animal distribution by land class were obtained within survey blocks. These estimates were then extrapolated over the entire range under the assumption that what was observed on the survey blocks occurred at the same frequency throughout the remaining range.

The growing abundance and range expansion of Saskatchewan's antelope herds has been documented by government authorities (Wiltse et al., 1980-89). However, we questioned whether or not antelope distribute themselves evenly over the different land classifications or whether there was some form of selection or avoidance at this time of year (early June) despite expansion into new ranges. Antelope observations made on the different land classes from all surveys combined were subjected to Chi square goodness-of-fit comparisons and Bonferroni z statistic. The former statistic was used to test the null hypothesis that antelope utilize each land class in exact proportion to its occurrence while the latter statistic examined preference or avoidance of land classes. Necessary adjustments to the "level of significance" of the intervals were made as described by Neu et al. (1974)[2].

The survey blocks were then merged into groups where: a) the combined surveyed area was predominately native vegetation[3], b) the combined surveyed area was a mixture of native and agricultural development[4], and c) the combined surveyed area was almost entirely agricultural development[5] (refer to Figures 4 and 5). Group arrangements were based on what we felt were the three universal habitat types occurring over the entire provincial antelope range. These groups were also evaluated by the above statistical examinations.

III. Point Observation of Groups

A point observation of the type of habitat on which an antelope group was first observed was also recorded. Habitat definitions were:

1. Native grassland (NGRS).

2. Seeded cropland (CROP).

3. Summerfallowed cropland (SRFW).

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[2]For a detailed description of the methodology used in these statistical procedures, see Neu et al. 1974. J. Wildl. Manage. 38(3):541-545.

[3]Survey blocks 2A, 2B, 2C, 3A, 6B, 7A and 9A.

[4]Survey blocks 1A, 4, 5, 9B, 10, 11, 14A, 14B and 14C.

[5]Survey blocks 4 and 5.

4. Seeded domestic grasses or forage cropland (CWGR).

5. Island habitat (eg. slough bottom or undeveloped knoll of a hill) surrounded by agricultural development (ISLD).

It was hoped that these observations would give some indication as to the possible affinity or selection of antelope to certain habitat types regardless of size. For example, on Class 4 quadrats (2 to 30% native habitat) would antelope be more consistently observed on one habitat type as opposed to the other four point observation types.

As was the case with land classification analysis, survey blocks and their respective point observations were broken into three groups: a) predominately native, b) mixed native and agriculture, and c) predominately agricultural. Unlike land classifications, the amount of area each habitat type encompassed was unknown. However, when each section was classified, it had been based on the amount of native vegetation remaining within its boundaries. Therefore, the amount of native and/or island habitat ranged in Class 1 between 90 to 100 per cent, Class 2 between 50 to 90 per cent, Class 3 between 30 and 50 per cent, Class 4 between 2 and 30 per cent and Class 5 between 0 and less than 2 per cent. The combined seeded and summerfallowed cropland and seeded forage constituted the remaining area of a section. Based on these lumping of habitat types, comparisons could be made by Chi square goodness-of-fit and Bonferroni z statistics.

IV. Number of Antelope per Group

As mentioned, the number of animals per group were recorded while Line Transect surveys were in progress. Mean group size figures are used in the final calculation of population size within the particular survey block or wildlife management zone (WMZ). Groups seen in Bands A and B were assumed to least likely contain sighting biases due to their close proximity to the aircraft while group observations in more distant bands would tend to be biased toward larger groups (Johnson and Lindsay, 1989). As a check of this assumption, group size data was tested to ascertain if sighting biases were present and in which bands.

V. Fringe Herds

Small, distinct pronghorn herds exist throughout the Farmland regions of Saskatchewan (Figure 4), occupying historic territory identified by Nelson (1925 cited by Hnatiuk, 1976; Figure 1) and Banfield (1974). Their continued existence is dependent upon mild winters with little snow cover. These herds may be associated with remnant parcels of native grasslands but the vast majority of their habitat base is agricultural lands. Since the mid-1970's, the frequency and size of these isolated herds has increased. However, aerial surveys were unwarranted owing to the cost involved to monitor such small numbers over a vast area. The best method to ascertain population sizes was to

ask knowledgable Saskatchewan Natural Resources (SNR) staff to estimate herd sizes and herd territories. Figure 4 depicts the results of these inquiries.

VI. Herd Structure

For economic reasons past herd structure surveys were incorporated into the trend line surveys. Saskatchewan's total antelope survey effort was designed to gather both population indices after parturition. From these surveys, preseason population estimates were made and harvest quotas assigned. However, this methodology was flawed in that it did not account for summer mortality, particularly important some years for kid survival and recruitment.

Although we were aware of the possibility of misleading recruitment data, sex and age surveys were flown in a Cessna 172 on July 5 to 8, 1990. In order to compare past years' results with 1990 and the immediate need to set the 1990 hunting season dates and quotas, it was necessary to accomplish herd structure surveys at that time.

Survey blocks were primarily chosen on the basis of historic precedence and were characterised by being vast areas of native rangeland. However, three new areas (WMZs 5, 10 and 11) were also chosen as representatives of areas with significant agricultural development.

Adequate sample sizes at a 80 per cent confidence interval for each survey block was calculated beforehand and were based on the 1989 herd ratio as well as mean population estimates derived from the June, 1990 Line Transect surveys. Sex/age data obtained in 1990 was then compared to data collected over a 30-year period (1960-1989) by way of Chi-square contingency tables.

Results and Discussion

I. Line Transect

Table 1 lists the best fit density estimates and their respective lower and upper limits for each survey block while Appendix II depicts their curve fit to the histogram of data. Also included in Table 1 is the mean antelope per group, area of survey block, and the population estimate and limits for individual survey blocks. When two or more survey blocks occurred in the same WMZ, they were combined such as is the case for Surveys 2A, 2B and 2C. A summary of density estimates by the different models is contained in Appendix II.

Burnham et al. (1980) recommended a minimum sample of 40 objects (in our case clusters) be counted on a survey, while, for conducting antelope line transects, Johnson and Lindsay (1989) recommended 40 to 100 group observations, 100 being optimum for a good density estimator. Five of the density estimates were made without the adequate number of cluster

samples (Table 1). These occurred in low or moderate density areas (Figure 4). Because of their wide confidence intervals, tight estimates of WMZ populations are lacking.

Table 1. Pronghorn antelope population estimates for 1990 Line Transect survey blocks. Distance bands A to E, inclusive.

Survey Block	Clusters	Number of Antelope	Density Estimate of Clusters (km^2)	Antelope/Cluster (Bands A to D)	Survey Block Area (km^2)	Estimated Survey Population (lower & upper limits)[a]
1A[b]	12	19	0.09	1.70	1,694	250 (19-489)
2A, 2B & 2C	332	606	0.52	1.63	3,776	3,222 (2,423 - 4,021)
3A	357	672	0.65	1.82	2,446	2,235 (1,476 - 2,992)
4[b]	33	55	0.14	1.65	1,259	287 (81 - 491)
5	55	97	0.15	1.38	1,259	265 (106 - 424)
6B	85	128	0.48	1.42	559	380 (213 - 547)
7A	128	225	0.54	1.78	1,327	1,265 (262 - 2,267)
9A & 9B	131	270	0.22	2.17	1,494	717 (471 - 962)
10[b]	37	73	0.18	1.86	606	199 (81 - 316)
11[b]	38	74	0.26	1.93	673	340 (74 - 755)
14A, 14B & 14C[b]	25	52	0.08	2.11	1,075	183 (52 - 340)
All Survey Blocks Combined	1,233	2,271	0.32	1.75	16,168	8,503 (7,213 - 9,793)

[a] P= 0.05

[b] Less than the minimum of 40 clusters observed.

A review of Figures 4 and 5 illustrates that for WMZs which had survey block(s) within their borders and contained more than one density range[6], the surveys most often were situated in only one density range, usually the higher of the two ranges. When the density estimate for a particular survey block was extrapolated over its entire WMZ, calculations were felt to exceed true population levels. WMZ 2 was a prime example in that when the density estimate for Survey Blocks 2A, 2B and 2C (all within the high density range) was extrapolated over the

[6]Delineation of density ranges were based on the authors' personal knowledge of past antelope concentration; refer to Figure 4.

entire WMZ, the estimated mean population was 8,925 animals. However, approximately one quarter of this WMZ falls within a moderate density range. In order to overcome this fault, survey blocks within respective density ranges were pooled (Table 2; Figure 8) and population estimates for each WMZ (Appendix III; Figure 9) were based on range densities and their area rather than individual survey blocks. Thus, the re-calculated mean population estimate for WMZ 2 was 7,316 antelope.

Table 2. **Pronghorn antelope population estimates for different density ranges as identified in Saskatchewan[a], June 1990.**

Density Range	Groups/km^2	Antelope/Group	Area (km^2)	Population Estimate	Lower Limit	Upper Limit
High	0.51	1.59	17,192	13,894	11,881	15,908
Moderate	0.14	1.79	32,025	8,220	5,568	10,872
Low	0.08	1.47	19,667	2,183	1,298	3,067
Range Extension[b]	N/A	N/A	22,000	1,390	N/A	N/A

[a] Refer to Figure 4 for density range locations.
[b] Estimate of Fringe herds supplied by SNR field staff.

Left - Population Right - Area

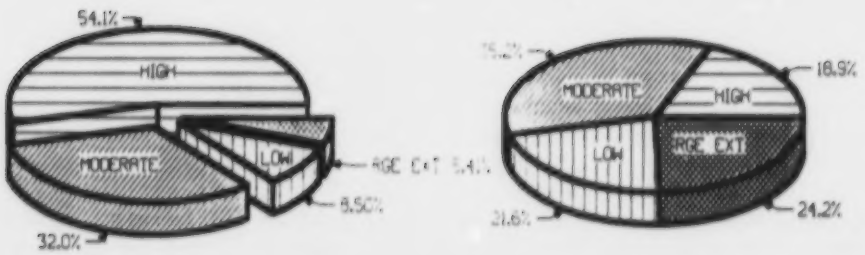


Figure 8. **Per cent of antelope population versus area (km^2) in each density range.**

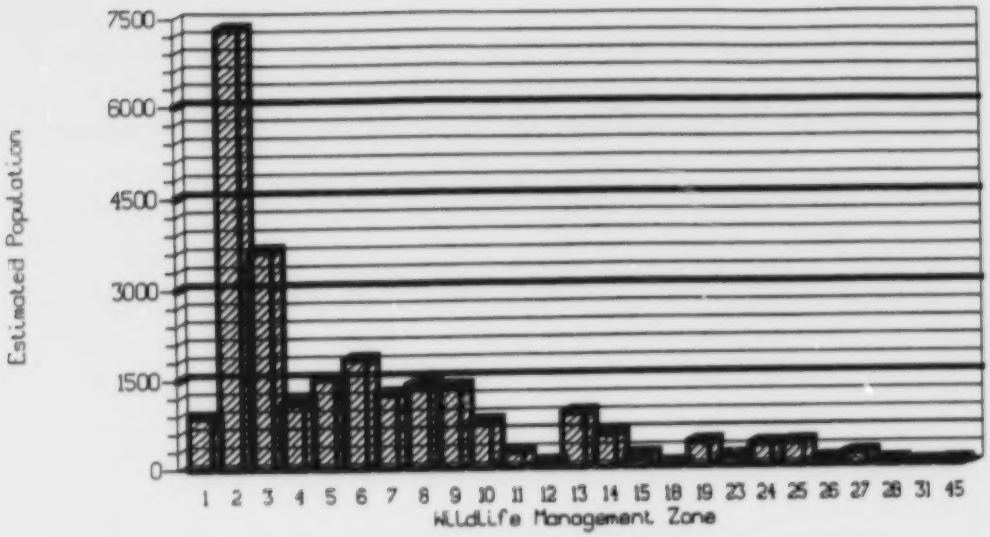


Figure 9. June 1990 adult antelope population estimate by wildlife management zone.

The sum of the estimates contained in Appendix III were considered to be the approximate adult population (24,720 animals) in Saskatchewan as of June, 1990.

II. Line Transect versus Trend Line and Stratified Block Methods

One of the advantages of the aerial survey technique Line Transect was that results could be compared with the traditional trend line method used in Saskatchewan since 1960. Trend line surveys are subject to a number of biases, not least of which is the visibility bias in which sightings favour large groups as opposed to single or small groups as distance increases from the aircraft[7].

Results of our comparison for the survey blocks are listed in Table 3. As can be seen, considerable differences in estimated mean densities and population sizes arose between the two survey methods. However, the trend line population estimates for all surveys, except for combined blocks 2A, 2B and 2C, fell within the lower ranges calculated by Line Transect. When the entire survey effort was consolidated, Line Transect range estimates became tighter and the trend line population estimate fell outside these ranges.

The differences between the two survey techniques were not statistically tested, however, we felt more comfortable with the Line Transect mean estimates based on department field staff and landowner reports, and our own personal impressions of zone populations. It was our consensus that use of the trend line method would have underestimated the 1990 adult antelope population in Saskatchewan.

[7] See the section on "Number of Antelope per Group", page 16 and 31 for a detailed analysis of visibility bias.

Table 3. Comparison of population densities and estimates as derived by trend line and Line Transect aerial survey techniques.

Survey Block	Trend Line		Line Transect			Difference between the Two Techniques' Estimated Means[a]
	Density (km^2)	Population Estimate	Density (km^2)	Population Estimate	Population Range	
1A	0.03	59	0.15	250	19 - 489	+ 323.7%
2A, 2B & 2C	0.54	2,041	0.85	3,222	2,423 - 4,021	+ 57.9%
3A	0.69	1,691	0.92	2,235	1,476 - 2,992	+ 32.2%
4	0.09	117	0.23	287	81 - 491	+ 145.3%
5	0.16	204	0.21	265	106 - 424	+ 29.9%
6B	0.43	242	0.68	380	213 - 547	+ 57.0%
7A	0.33	487	0.95	1,267	262 - 2,267	+ 160.2%
9A & 9B	0.34	509	0.48	717	471 - 962	+ 40.9%
10	0.22	136	0.33	199	81 - 316	+ 46.3%
11	0.20	135	0.51	340	74 - 755	+ 151.9%
14A, 14B & 14C	0.09	95	0.17	183	52 - 340	+ 92.6%
All Survey Blocks Combined	0.33	5,336	0.56	8,503	7,213 - 9,793	+ 59.4%

[a] Per cent difference from trend line mean estimate to Line Transect mean estimate.

Land use classification of each square mile within the survey blocks afforded us the opportunity to compare a form of stratified block analysis against Line Transect. Each square mile on a transect line was treated as separate block or quadrat and placed into strata based on their land classification. Frequency tables were constructed (Appendix IV) and analyzed based on Stewart's (1983) description. Although calculated bounds were much tighter for the stratified technique as opposed to Line Transect, mean estimates were very similar to that of the trend line results and were again felt to be an underestimate of the actual antelope population size.

In fairness to the stratified block technique, our survey design was developed for strip-type surveys and, therefore, biased toward these techniques. In order to accurately compare strip line surveys and a form of stratified block, the stratified quadrats should have been randomly selected and flown separately. As well, adequate quadrats for each stratum should have been calculated beforehand as we later found samples in certain strata to be insufficient. Finally, the quadrats were not intensively flown so that unobserved antelope on the outer limits of a quadrat were not enumerated.

However, when designing the antelope survey program for 1990, we were aware of previous studies comparing stratified random block and strip line techniques: 1) Pojar et. al. (1982) and Firchow et. al. (1990) found significant differences between the two survey methods. Both groups felt the stratified block technique consistently over-estimated antelope population size. 2) Hnatiuk (1976) converted Dirschl's (1960b) trend line surveys into stratified samples, however, his blocks were divided into much larger (ie. area) units than our one mile squared quadrats. Hnatiuk (1976) concluded stratified block analysis was not specific enough due to their broad range estimates. Based on these previous studies and our findings, we did not feel further stratified random block studies were warranted.

III. Stratification of Blocks

Based upon land classification figures in Appendix IV, the core of present day antelope range in Saskatchewan encompasses approximately 65,000 km^2 (Figure 4), larger than that area described by Dirschl (1960a). Range expansion since 1960 has contributed an extra 22,000 km^2 to this total, however, only 1,500 km^2 is actually occupied by fringe populations.

It was expected that a certain portion of each land class would have changed from the date of aerial photography (1979-80) to present day. Most of this change was due to agricultural development while a minor portion was a result of misinterpretation of photomaps. Overall Class 1 lands changed 20 per cent, Class 2 lands 26 per cent, Class 3 lands 30 per cent and Class 4 lands 10 per cent owing to agricultural "improvements". Of course the only change which befell Class 5 lands was due to misinterpretation. A complete summary of land classification changes for each survey block and all blocks combined is contained in Appendix V.

The frequency tables constructed in Appendix IV were used to test for adequate sample sizes in each land class using estimates of variance and means already derived in the completed surveys. A finite population correction factor was used when applicable. Satisfactory samples ($B = 0.1$; $P \leq 0.05$) had been obtained for all land classes when viewed on a provincial perspective. However, when survey results were test against their respective WMZs, representation of a number of land classes was inadequate.

Estimates for average number of adult antelope per quadrat (mi^2) was the highest for Class 1 lands, being 1.43 per quadrat, and declines progressively as the amount of native habitat dwindles (Appendix IV). Forty-six per cent (46%) of the Class 1 lands surveyed had one or more antelope while Classes 2, 3, 4 and 5 lands had 36 per cent, 25 per cent, 18 per cent and 17 per cent, respectively. Figure 10 and Appendix VI depicts the frequency and size of antelope groups for each of the five land classifications. These results indicated selection or preference by antelope for land classes of predominately native range.

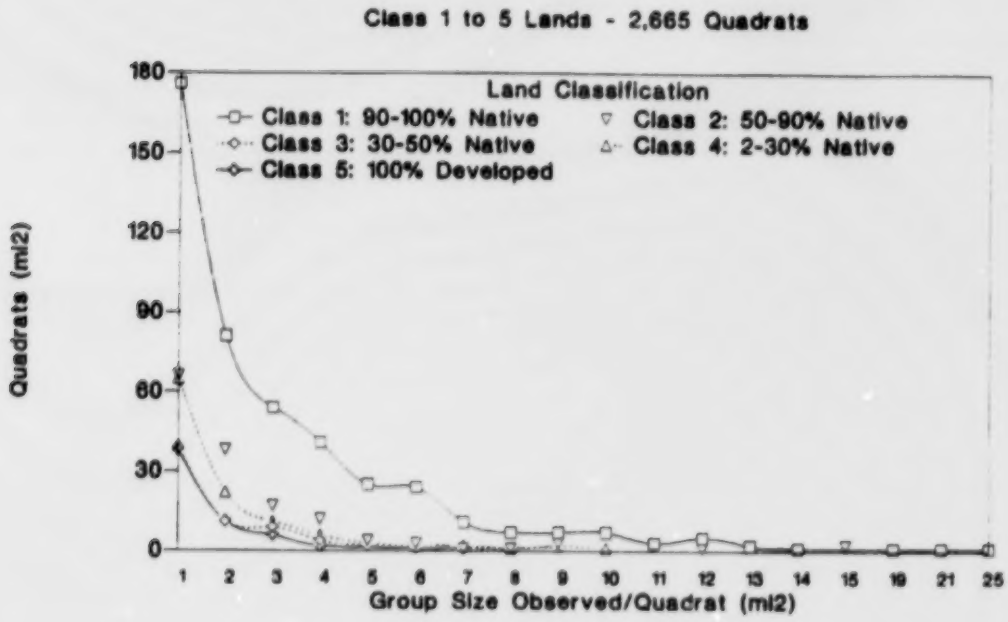


Figure 10. Frequency and size of antelope groups observed on five land classifications.

To test whether or not antelope were selecting for certain land types, goodness-of-fit comparisons were made of antelope observations for the four survey groups (ie. all survey blocks combined, survey blocks which were predominately native vegetation, survey blocks which were mixed native and agriculture, and survey blocks which were predominately agricultural). This revealed that the expected number of antelope in each land class category differed significantly ($P \leq 0.05$) from the actual occurrence of antelope within land classes (Appendix VII). Land classes 4 and 5 for the "predominately native" survey group were combined because of insufficient sample ($np < 5$)[6]. Similarly classes 1 to 4 were combined in the "predominately agricultural" group comparison. In the case of this last group comparison, the hypothesis was modified somewhat to test whether or not antelope occurrence indicated selection for land classes with some remaining native vegetation (classes 1 to 4, inclusive) as compared to Class 5 which basically had none or trace amounts.

[6]The Bonferroni z statistics is a normal approximation for a variable which follows a binomial distribution, therefore, if p (proportion of antelope observed in each land class) is close to 1 or 0, n (sample size for each land class) should be large enough to maintain a good approximation (Neu et al., 1974). Conservatively, if np and $n(1-p) \geq 5$ the sample is sufficient.

In order to identify which land classes were creating statistical significance in the Chi square test, individual confidence intervals were constructed by way of the Bonferroni z statistic for each theoretical proportion of occurrence (Appendix VII). The results indicated that antelope either selected[9], avoided[10] or occurred as expected[11] on the different land classes. These estimated (observed) and hypothetical (expected) occurrences are illustrated in Figure 11.

Based on the results of these tests (Figure 11; Appendix VII), we concluded antelope select for land classes which are predominately native vegetation while avoiding lands that are developed. Even in areas where agricultural activity was a major aspect of the landscape, antelope occurred more frequently on land classes with the greatest amounts of remaining native habitat. Because our surveys were flown at a single point in time (early June), we cannot conclude that antelope selection or avoidance of land classes we observed hold true for all times of the year in these survey areas. Antelope utilize large and varied tracts of land over the course of a year (Hnatiuk, 1976; Mitchell, 1980). However, Hnatiuk (1976) found that out of 9,044

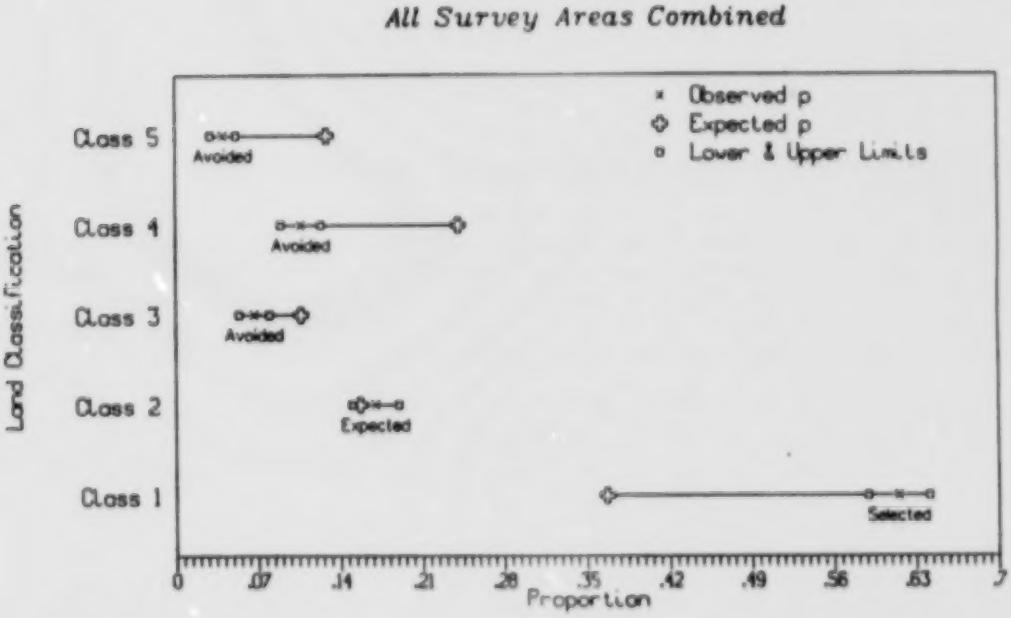
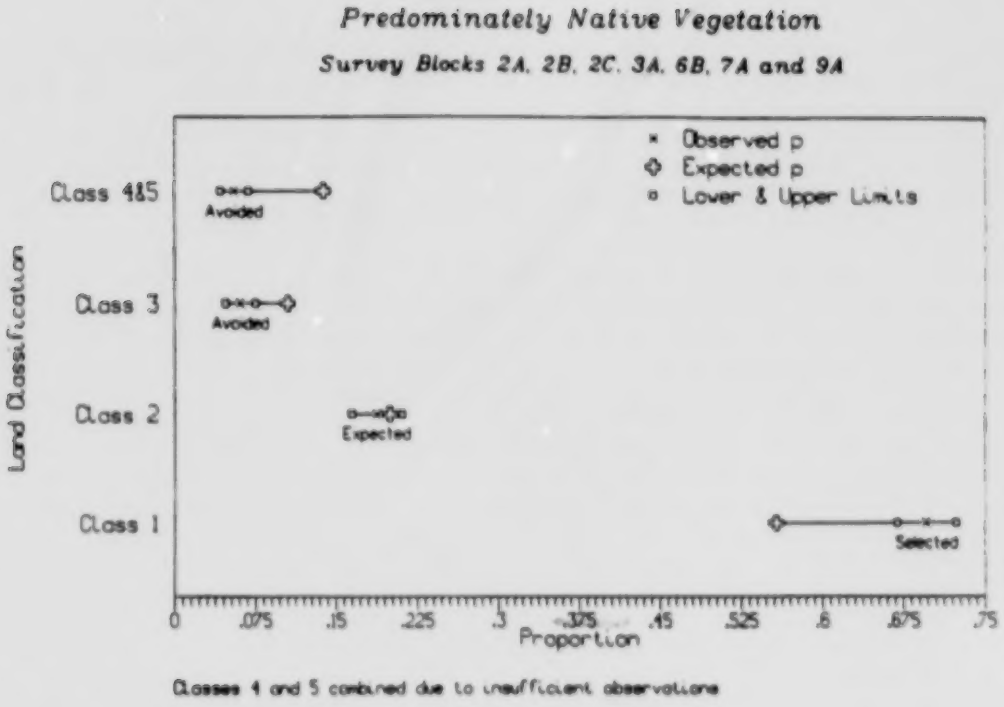


Figure 11. Observed, expected and confidence intervals of antelope occurrence on different land classifications.

[9]Observed occurrence was greater than the expected range of occurrence according to land area, thereby indicating selection for this land class.

[10]Observed occurrence was less than the expected range of occurrence according to land area, thereby indicating avoidance for this land class.

[11]Observed occurrence fell within the expected range of occurrence according to land area and animal observations, that is, there was no statistical evidence to suggest that antelope were selecting or avoiding this land class.



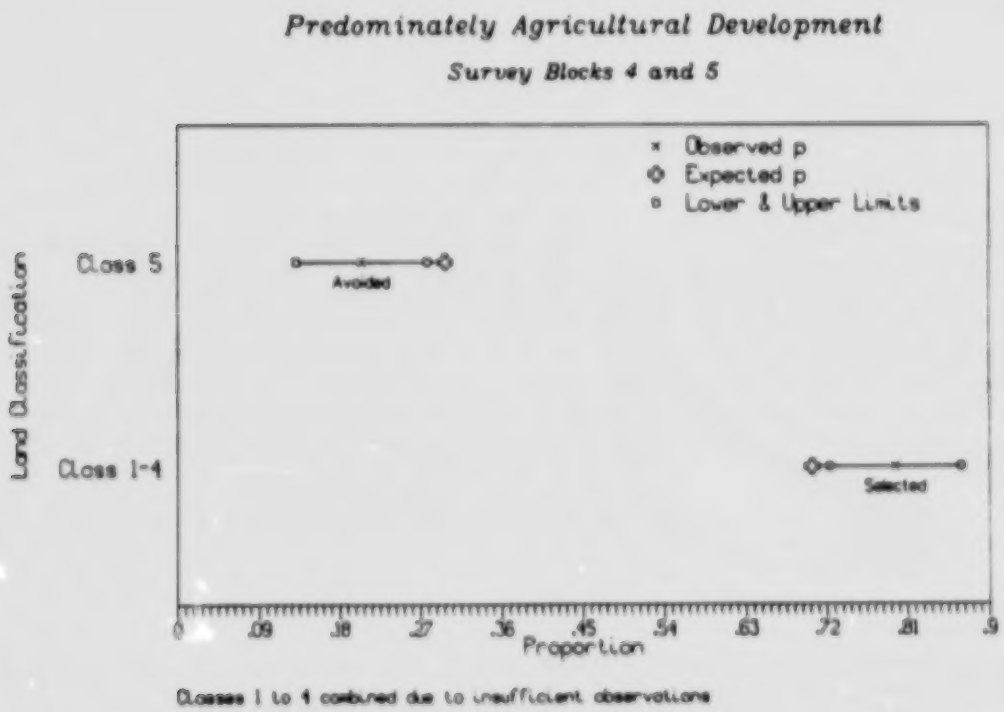


Figure 11 (cont'd). **Observed, expected and confidence intervals of antelope occurrence on different land classifications.**

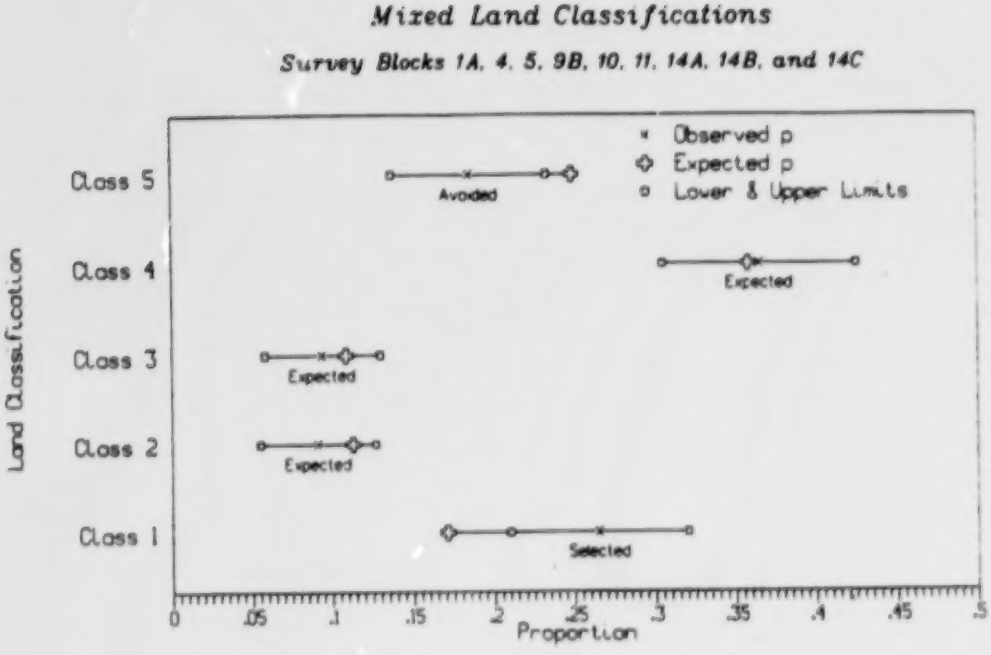


Figure 11 (cont'd). **Observed, expected and confidence intervals of antelope occurrence on different land classifications.**

individual antelope observations made over a 12 month period, 72 per cent were made on native habitat types while 28 per cent were on disturbed lands (summerfallow, domestic grass/alfalfa, spring seeded cereal crop and stubble). Hnatiuk's earlier work appears to support the notion that our selection findings are more or less true throughout the year.

IV. Point Observation of Groups

One thousand three hundred ninety-seven (1,397) antelope were observed on Class 1 lands. Of this total, only two animals occurred on habitat types other than native grassland. Although the classification criterion (90 to 100% native habitat) allowed for as much as 10 per cent (26 ha) agricultural development, the majority of Class 1 lands were entirely native. As a result, analysis of habitat preference omitted Class 1 point observations because of its obvious bias toward a 100 per cent native range (ie. antelope could not select another habitat type because there was none).

Mean values for each habitat type across the different land classifications (classes 2 to 5, inclusive) were tested by the Kruskal-Wallis statistic. Calculated estimates did not reject the null hypothesis (P>0.05) that samples came from identical continuous populations (Figure 12). Therefore, group size did not differ between the different habitat types[12].

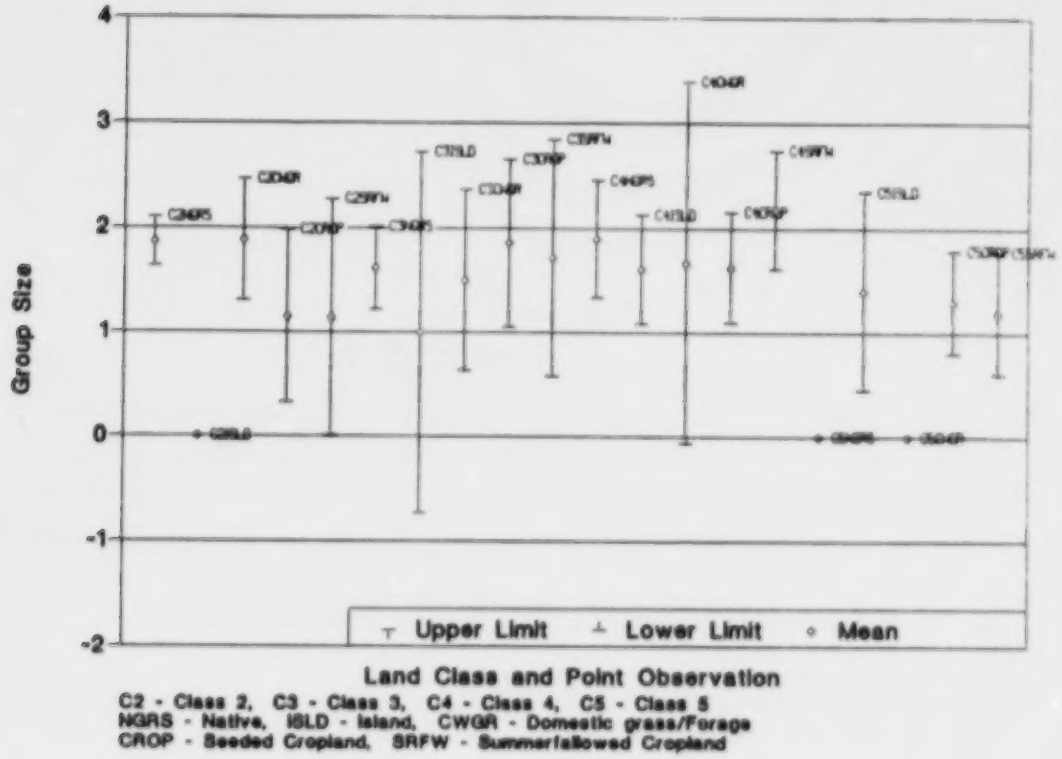


Figure 12. Mean and confidence intervals of group size from different land classes and point observations.

However, goodness-of-fit and Bonferroni *z* comparisons of the expected and observed number of antelope in native habitats (native grasslands and island habitat) versus developed habitats (cropland and forage) did differ significantly (P≤ 0.05) and demonstrated selection for native vegetation types across the different land classes[13] (Appendix VIII). One exception was when Class 2 lands were assumed to contain 90 per cent

[12]Mean and standard error values ranged from 1.0 to 2.2 and 0.3 to 1.5, respectively. This, along with the demonstrated selection of certain land classes and habitat types, supported the previous assumption that early June was the best time to survey antelope if a wide dispersion of animals is desired.

[13]No animals were observed on island habitat types in Class 2 lands, therefore, comparisons were solely native grassland versus developed lands. Likewise no observations were made on native grasslands nor domestic grasslands - forage croplands in Class 5 lands, thus, comparisons only included island habitats versus cropland.

native vegetation. Antelope appeared to prefer the developed area but this was rejected as we felt the average Class 2 acreage consisted of more than 10 per cent development. When the level of native vegetation was estimated at 85 per cent, no preference for native versus developed was detected, while at a level of 75 per cent native vegetation, there was selection for the native habitat.

Goodness-of-fit test rejected the null hypothesis that antelope were distributed evenly in island and developed type habitats in Class 5 lands. However, antelope counts in island habitats lacked sufficient observations and, thus, violated the np or n(1-p) > 5 requirement for the Bonferroni z test (Appendix VIII). As a result, the "selection" of island habitats and "avoidance" of developed habitats conclusion may be suspect. However, if antelope were randomly distributed, the probability of them occurring on the developed portions of the quadrats should have been greater and the null hypothesis in the goodness-of-fit test should not have been rejected. We must also consider that many of the Class 5 lands did not have any small pockets (islands) of remaining native habitat and, thus, antelope were not able to select or avoid different habitats other than developed habitats on these blocks. Based on these facts, we concluded antelope were selecting, for whatever reason, island type habitats on Class 5 lands when available.

V. Number of Antelope per Group

Mean group values per distance band varied from survey block to survey block although many times there was no statistical difference ($P > 0.05$) between bands. In most cases, however, means did rise as observation distances increased from the aircraft. When survey blocks that fell within their respective high, moderate or low density areas (Figure 4) were combined (thus, larger sample sizes), greater differences between band group sizes within density areas were detected. Analysis of variance of the high density area demonstrated a very significant difference ($P \leq 0.01$) between bands, probably owning to larger sample sizes. On the other hand, differences in band means in moderate density and low density areas were not as statistically evident ($P = 0.25$ and 0.28, respectively), although there was a general increase in mean values per band as distances increased from the aircraft.

Group size data from all surveys were combined and the resulting analysis of variance disclosed a strong difference ($P \leq 0.01$) between bands (Figure 13; Appendix IX), although when tested one against the other by Fisher's least significant difference test, the only significance occurred between Band E versus Band A, versus Band B and versus Band C. Bands A and B were then combined per recommendation in the Wyoming Line Transect manual (Johnson and Lindsay, 1989) to test whether or not mean values per band differed[14]. Like the previous analysis of variance test there was a strong dissimilarity ($P \leq 0.01$) between band means, enlarging in value as distance increased from the aircraft. (Appendix X).

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[14]As there was no significant difference ($P>0.05$) in our data between Bands A and B, this combining of band groups was thought to be acceptable.

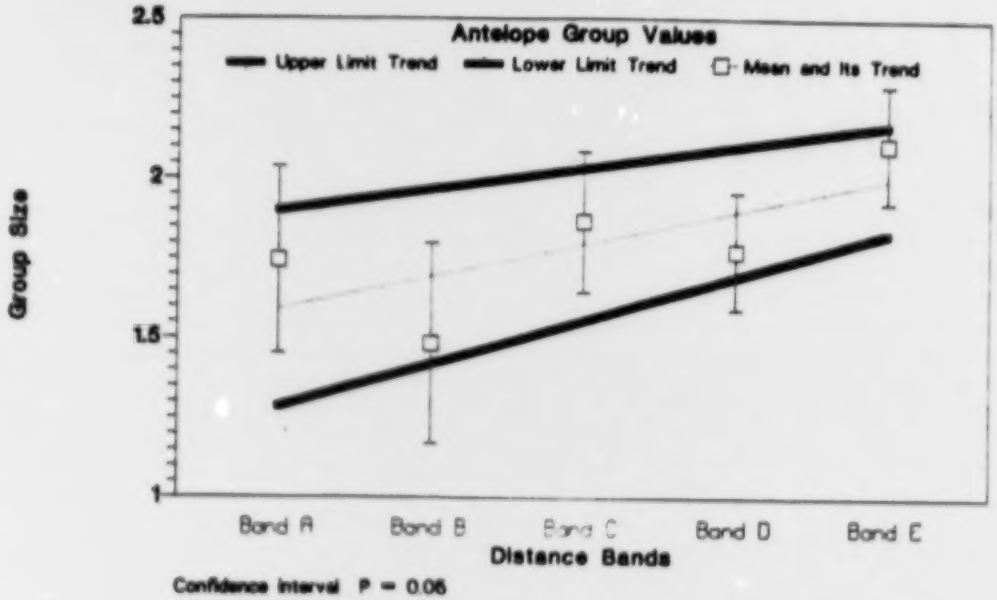

Figure 13. Increasing group mean and declining group variation as distance increased from aircraft.

Another indicator of visibility basis was the standard error of the mean which was derived from the above analyses (Appendices IX and X). Inevitably for all survey blocks and combination of survey blocks, standard errors declined from Band A to Band E (Figure 13). This change was thought to be evidence that the sighting of single or small groups was being missed as distance increased from the aircraft, that is, the variation of group sizes about the mean declined.

Based on the deviation between band means and standard errors, we concluded that the most accurate group size values were derived from observations made in Bands A and B while sightings made in bands further out were subject to biases favouring larger groups. This finding concurred with that recommended by Johnson and Lindsay (1989)[19].

VI. Fringe Herds

As seen in Figure 4, small groups of antelope occur outside the major antelope range. From estimates made by SNR field personnel, as many as 1,400 antelope may inhabit pockets of Farmland habitats (Tables 2 and Appendix III). Based on the total population estimate, these groups constitute only 5 per cent of the provincial pronghorn antelope population (Figure 8).

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[19]Interestingly, the example supplied in the Wyoming Line Transect manual of an actual survey (Rattlesnake Antelope Line Transect survey) did not demonstrate significant difference (P= 0.52) between cluster mean sizes within bands, although standard errors did decrease inversely with distance from the aircraft.

VII. Herd Structure

Results of the early July sex/age survey are illustrated in Table 4. Both buck to doe and kid to doe ratios dropped slightly in 1990 as compared to 1989 (Appendix XI), however, this decline in proportions was not significant (X^2= 0.67, df= 1; P= 0.05). The proportion of bucks (53:100) was up slightly from the 1960 to 1989 average of 51 bucks per 100 does but again this increase was not significant (X^2= 0.04, df= 1; P= 0.05). On the other hand, the kid to doe ratio (61:100) was significantly below (X^2= 3.59, df= 1; P= 0.07) the long-term of 71 kids per 100 does.

Table 4. Results of herd structure surveys, July 5 to 9, 1990.

Survey Block	Yearling Bucks	Mature Bucks	Total Bucks	Adult Does	Kids	Total Animals	Herd Structure (Bucks:Does:Kids)	Precision of Sample (Ratio Range) (P≤ 0.2) Bucks	Kids
2A, 2B & 2C	30	66	96	114	81	291	84:100:71	77-91:100	64-78:100
3A	34	48	82	150	95	327	55:100:63	50-60:100	58-68:100
5	24	14	43[a]	57	71	171	75:100:125	66-84:100	111-139:100
6 & 7	15	37	52	171	60	283	30:100:35	27-33:100	32-38:100
9A & 9B	7	17	24	76	41	139	32:100:55	28-36:100	48-62:100
10 & 11	3	10	13	21	12	46	62:100:57	48-76:100	44-70:100
Total	113	192	310	587	360	1,257	53:100:61	51-55:100	58-64:100

[a] Includes adult males of unknown age.

Throughout this document we make mention to, or illustrate, the growing antelope population in Saskatchewan (Figure 3). Surveys techniques previously outlined, literature cited and population modelling (to be described later) all lead to the conclusion that antelope numbers are at their highest point since before the turn of the century. We feel that herd structure results also support this deduction.

The general trend since 1971 has been to enlarging buck to doe ratios (Appendix XI) despite increased either sex licence quotas (in most years) and hunter selection for bucks. We feel more mature bucks were surviving year after year. In addition, there was a high annual recruitment due to the large population of does and generally good climatic conditions for fawn and yearling survival. As a result, these two events have contributed to favourable buck numbers throughout the antelope range.

Kid to doe ratios have been lower than the long-term average for the past three years (Appendix XI). It would be easy to conclude that this was due to poor fawn survival and, thus should result in a population decline. However, this has not been the case. Generally, trend line survey densities have been increasing and were at an all time high in 1988 and 1989. Reports from department field staff and local residents support the concept of population growth. Therefore, we feel the lower than average kid to doe ratios were probably a result of high recruitment rates of previous years' fawns. As a result, a notable proportion of the does enumerated were most likely yearlings and, therefore, not expected to produce young that year. Again, the prominent yearling buck to mature buck and total buck to doe ratios support the concept of high recruitment rates, not poor reproduction.

Historic Harvest Management

Archival references for 1898 make mention of considerable discussion in the press for the protection of game in the Northwest Territories (Anonymous, 1898; Appendix I). The Game Ordinance was already formally in existence but organized hunting seasons and licences were not yet established. Game populations were dwindling and what wildlife that remained was continually under pressure by "land seekers" (homesteaders) and "roaming Indian bands killing large number of big game" (Anonymous, 1901). In 1899, Game Guardians issued the first general game licences to 20 residents and 9 guests for all of the Northwest Territories. Low licences sales persisted until 1914 when the Saskatchewan Legislature added the antelope and the whooping crane to a list of game species which would be completely protected for an indefinite period of time.

The antelope remained protected until 1936 (Appendices I and XII) at which time a short, open season was allowed (Anonymous, 1936). Two hundred sixty-seven (267) animals were reported harvested. From this point onward, the department has recorded the sex composition of either sex seasons when held. But it has only been since 1960 that both sex and age (ie. kid or adult) structures have been documented. Male and female harvest numbers were about equal until 1960 when season dates were moved from early or mid-November to late October. If hunters had wished to select for bucks, the later season may have made identification of sex at a distance difficult as many bucks had probably cast their horns by this time. Since 1960, however, bucks have been the principal component of the annual harvest.

Two other events may also have contributed to the increase of bucks in the harvest. First, field staff reported increasing numbers of hunters who were using scopes rather than open sites on their rifles and that the rifles themselves were becoming more accurate at greater distances. Second, the conservation ethic of preserving the species' reproductive capability by taking males rather than females was becoming more widely practised by the hunting fraternity. This philosophy has evolved into today's "trophy" viewpoint where some hunters will only shoot the most desirable animal (in their minds at least), that is, the buck. "Buck hunting" was also supported by contemporary management objectives where the department consciously recognizes the demands of hunters for access to mature bucks with horns intact.

Figure 14 illustrates the harvest structure as it has been since 1960. When tested by Chi square, the year to year proportions of the harvest (as reported by hunters) were significantly different (Ps 0.05). The reason for variation in harvest structures is not clear, but weather, population densities, horn shed and starting dates of season no doubt influence annual kill ratios.

The department operated pronghorn antelope check stations off-and-on from 1957 to 1978. One of the objectives was to obtain firsthand information on animal selection by hunters. We tested check station results against those harvest structures reported by hunters in the Big Game Hunter Questionnaire (BGHQ) (Table 5). Data given by hunters were significantly different (Ps 0.05) than

that obtained at check stations for each of the 11 years compared. Therefore, we concluded that the information supplied by hunters over this 1960 to 1978 was inaccurate and that future hunter survey information should be closely scrutinized.

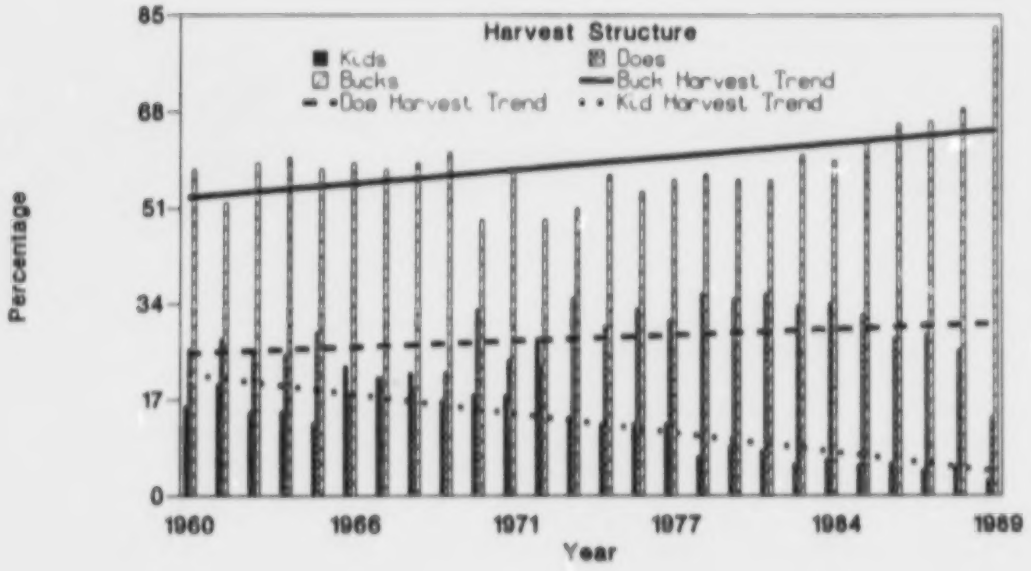

Figure 14. Harvest structures (%) and trends as reported by hunters, 1960-89.

Table 5. Comparison of harvest structure as reported in the Big Game Hunter Questionnaire (BGHQ) and check stations*.

	BGHQ Harvest Structure				Check Station Structure			
Year	Adult Male	Adult Doe	Kid	Ratio	Adult Male	Adult Doe	Kid	Ratio
1960	1857	833	512	223:100:61	227	302	238	75:100:79
1961	937	504	360	186:100:71	86	138	118	62:100:86
1967	560	203	203	276:100:100	62	74	46	84:100:62
1968	1565	504	583	311:100:116	74	76	66	97:100:87
1969	1306	471	364	277:100:77	252	152	126	166:100:83
1970	1697	1143	624	148:100:55	446	308	235	145:100:76
1971	1796	744	557	241:100:75	322	247	221	130:100:89
1972	1192	560	681	213:100:122	238	212	210	112:100:99
1976	788	483	189	163:100:39	103	84	82	123:100:98
1977	782	433	181	181:100:42	115	67	66	172:100:99
1978	822	519	101	158:100:19	90	51	35	176:100:69

* Significant differences ($P < 0.05$) were detected for all years between what hunters reported on the BGHQ and what was observed by department check station staff.

Supporting our conclusion, that the hunter reporting systems was biased toward the harvest of bucks, were the 1977 and 1978 reporting error studies conducted on antelope hunters (Balez et al., 1977 and 1978). Hunters who had their animals examined at a check station had their names and addresses tracked and were sent a normal big game questionnaire later in the year.

In 1977, overall reporting error was 26 per cent from a sample of 93 hunters. Sex was incorrectly designated on 6 per cent of the animals. Age information was reported erroneously on 23 per cent of the surveys with 40 per cent of the fawns designated as adults or age unknown. Hunters reported a buck to doe to kid harvest structure of 139:100:48 compared to 134:100:86 observed by check station personnel.

In 1978, reporting error from a sample of 90 antelope hunters declined to 17 per cent. Sex was incorrectly designated on 6 per cent of the animals. Age information was reported erroneously on 13 per cent of the surveys with 69 per cent of the fawns designated as adults or age unknown.

Another interesting outcome of our look at historic check station data was that harvest ratios up to and including 1968 were approximately equal for the three segments of the population (Table 5) and did not differ significantly ($P > 0.05$) from year to year. However, from 1969 onward bucks predominate the harvest, but not at levels as high as reported by hunters. Doe and fawn harvests remained similar. Harvests between 1969 and 1978 revealed no significant difference ($P > 0.05$) in sex/age structures. The one exception was 1972 when the proportion of bucks at the check stations fell. We suspect the reason for this drop in the buck harvest may have been a result of a declining antelope population as aerial survey densities estimates fell significantly ($P \leq 0.05$) from 2.07 animals per km^2 in 1971 to 1.11 animals per km^2 the following year. Hunter effort was also on the rise and increased from 1.5 hunter days per animal in 1971 to 1.7 in 1972 and 2.3 in 1973. Following the severe winter of 1973-74, the season was closed.

Based on these tests we were able to pool check station harvest structures into two groups, one where harvest structures were about equal for all segments and another where bucks predominated. Chi squared analysis computed a significant difference ($P \leq 0.05$) between groups. As a result, we believe this shift of antelope hunters harvesting primarily bucks occurred somewhat later than 1960 as reported by hunters, but never the less has occurred and persists today.

Population Modelling

Hnatiuk (1976) used a biological (model) approach to estimate antelope population performance. He concluded that the biological method was superior to aerial surveys because it considered many variables which affect the year round performance of antelope. Population changes could thus be predicted in advance rather than monitored after the fact as was the case with aerial surveys. Wide fluctuations inherent to aerial surveys were moderated in the model method and represented more of a biological portrayal of antelope population dynamics. In view of these factors, Hnatiuk recommended that models be phased in as a primary management tool with further research directed at obtaining accurate information on certain aspects of the model[16]. However, his recommendations were not acted upon until the formation of PAMP.

Today, population models can be easily and quickly run on desktop computers. They allow the wildlife manager to test the influence of a number of management strategies or environmental conditions on population dynamics. Population models are intended to be a tool to help organize and analyze data, simulate management strategies, and answer questions. Models assist managers to evaluate data quality and identify data gaps, thereby improving survey effort. However, models are only a means to an end; management solutions must still come from the managers.

In this study the population model program called Pop II, version 6.3 (Bartholow, 1986) was utilized. Three population scenarios (models) were created for the provincial population (Figure 15). They all had a postseason 15,000 animal population objective, however, the time frame in which this objective was reached differed between the three. The first model (Appendix XIII) maintained the 1990 either-sex licence quotas and harvest values through to the 1994 hunting season. Over the past three years, more and more of the successful Big Game Draw applicants have originated from lower priority pools (Appendix XIV). As a result, it was felt that a saturation point was at hand and was possibly close to the 1990 licence allocation of 6,400 either-sex licences. Although the high either-sex licence quotas eventually caused a decline in the population (Figure 15), the model did not address the demands of landowners for the immediate removal of a significant portion of the antelope population. Moreover, continuation of the buck harvest at the level reported in the Big Game Hunter Questionnaire Survey would result in the over harvesting of mature males. A more sex specific harvest strategy was required to meet prompt and future needs to stabilize the population at 15,000 animals.

In the second model (Appendix XIII), in which sex specific licences were incorporated but at a moderate level, the population objective was not reached until 1994. This was deemed too long a period to wait given the present climate of landowner concerns.

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[16]Ross (1975) also advised the department of the need for population models for each big game species in Saskatchewan.

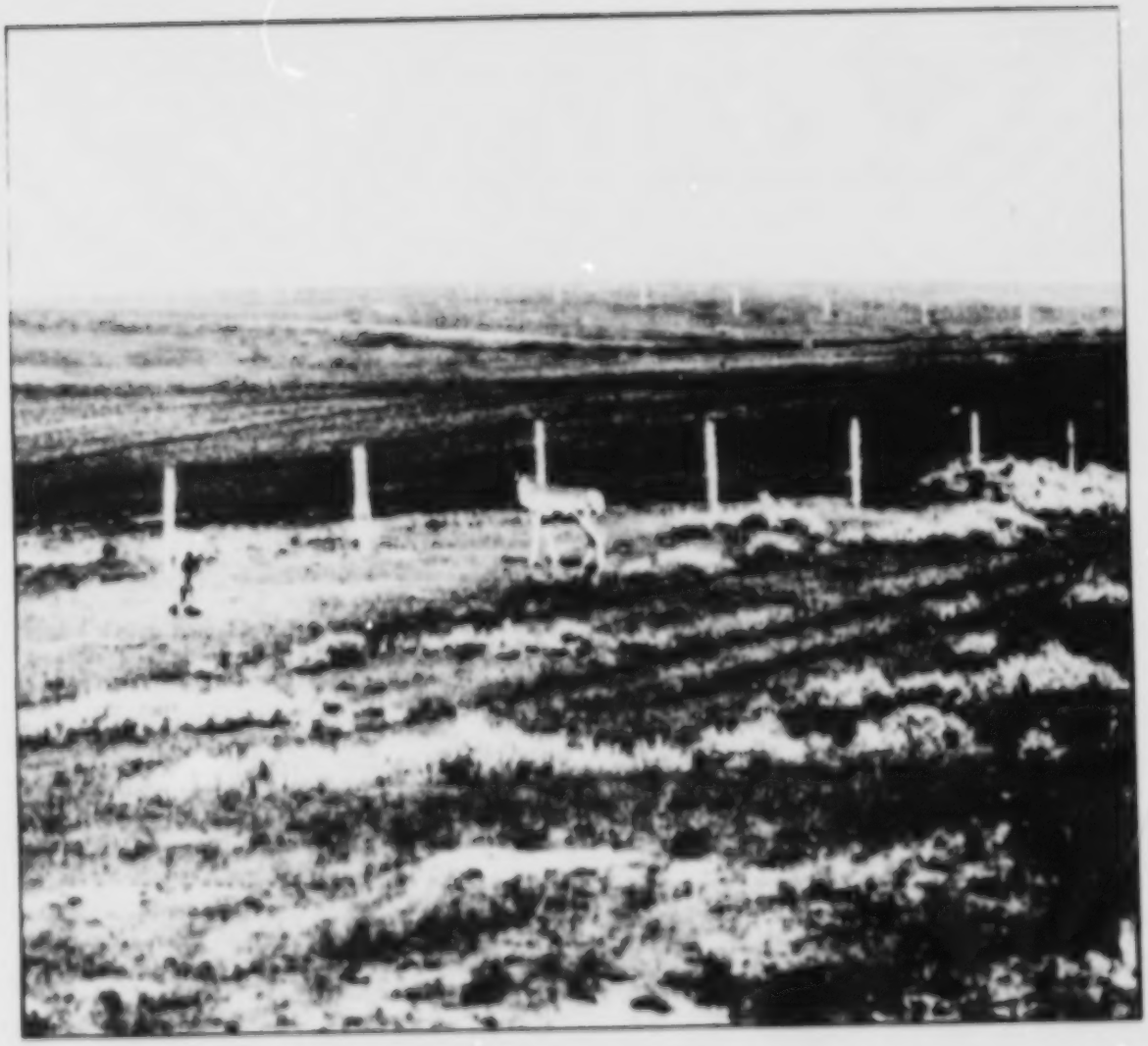
Figure 15. Postseason population trends based on three different harvest strategies.

Finally, the third model (Appendix XIII) met the 15,000 animal objective in 1992. Although approximately 9,900 antelope (12,000 licences) would be harvested, it was considered the best alternative in light of landowners demands for immediate reduction in the antelope herds. This record number of licences was, however, considered workable to minimize the potential problem of hunter over-crowding and hunter-landowner conflicts (Figure 15). Further modification, upward or downward, to the population objective could be accommodated as a reservoir of about 14,000 animals would remain.

The true harvest structure was a major variable which affected the models' predictive capabilities. Data presented in Table 5 clearly shows that there was a marked difference ($P \leq 0.05$) in what SHR staff observed at the check stations and what hunters reported as harvest. Based on these observations, and the 1977 and 1978 tracking of known hunter kills at check stations versus their reported kill, predicted harvest structures in 1990 and future years were projected by using check station averages from 1969 to 1978 rather than hunter questionnaire averages. This "alignment" had a profound impact on the number and type of licence required in 1991 to meet our post-season population objective.

Another variable which will impact on the predictability of these models would be the movement of animals in and out of WHZs and the province. Archival information from 1947 onward made many references to large groups of antelope moving in or out of the province from or to Alberta and Montana. Both Hnatiuk (1976) and Mitchell (1980) found evidence to conclude that antelope of the Canadian Great Plains were "relatively sedentary on their summer range", "... exhibited a strong fidelity for their natal range", and "... made large-scale movements to winter ranges only when environmental conditions were extreme" (Mitchell, 1980). Because of these findings, antelope models will have to be adjusted to account for population flux following severe environmental changes such as a harsh winter or drought.

Social and Economic Benefits[17]



[17]Consumptive (ie. hunting) benefits, only. Non-consumptive and other wildlife activities contributed $743.6 million in expenditures in 1987 (Filion et al., 1990), but what portion of this can be attributed to antelope is unknown.

Social Value

The net social worth of pronghorn antelope hunting, or any hunting for that matter, involves intrinsic benefits which add to the participant's quality of life or peace-of-mind gained through that activity. These are almost impossible to measure, and even harder to explain to the non-hunter, but do exist and make up an important aspect of the hunting experience. However, to quantify social benefits, one may only measure numerical figures such as hunter demand and participation in the sport. Ross (1973) described demand for big game hunting as "the number of users of the resource, number of user- or hunter-days, number of trips and hunting expenditures.

Since the early 1950's, antelope hunting has enjoyed an adequate demand to meet management needs, but was less than that for other big game species (Ross, 1973)[18]. Ross, in his socio-economic study of big game hunting in Saskatchewan, found that of all the big game species, hunters which hunted antelope were motivated by the recreational value of the activity while the remaining ungulate species were hunted for meat primarily and to a lesser extent for recreation[19,20]. One aspect of this demand has been the distance ardent antelope hunters were willing to travel in order to participate in the sport. In 1963 and 1964, hunters questioned at check stations reported travelling one-way from home an average of 340 km and 369 km, respectively. Ross found antelope hunters averaged 808 km in pursuit of this species[21], but were not prepared to make much more than one trip to harvest this ungulate. Compared to other big game species, antelope had the least average number of trips per species being 1.2 trips as compared to the average number for all big game of 4.1 trips, normally 835 km per hunting season. In addition, only 39 per cent of the respondents hunted more than one species per year. Therefore, based on the average distance covered for antelope versus all big game combined and the number of species a hunter was able to hunt, it would appear that hunters most likely curtail other hunting activities for that year they hunt antelope. These figures have probably changed little to the present owing to the distance harvestable antelope populations are from the major population centres in Saskatchewan.

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[18] First choice of species which respondents preferred to hunt in 1973: Moose = 38.0%, White-tailed deer = 36.0%, Elk = 13.0%, Antelope = 6.3%, Mule deer = 6.0%, Bear = 0.4%, Woodland caribou = 0.2%.

[19] Hunter motivation for other species may have changed somewhat from the time of Ross' (1973) findings to the present.

[20] Antelope hunters preferred to hunt in larger hunting parties than for other big game species (Ross, 1973), therefore, it may be concluded that this activity had a social bonding benefit as well as recreational benefit to the individual hunter.

[21] Includes distance to hunting area, travel in search of animals and return trip home.

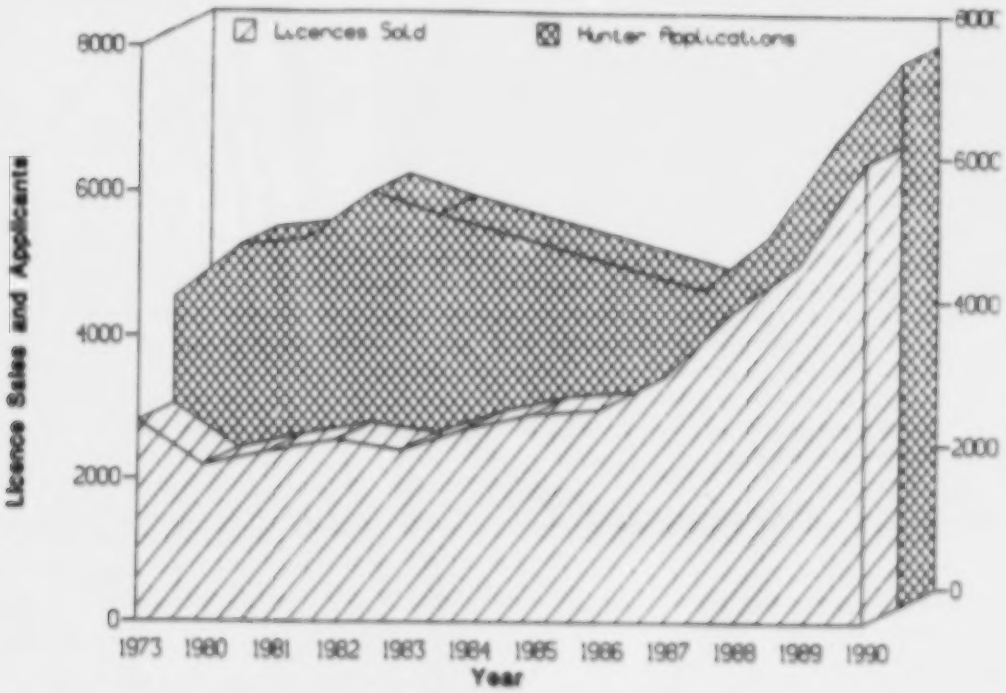
Compared to other big game species, antelope do not furnish a great deal of recreation per participating hunter (Table 6) nor do they supply a great deal of meat in relation to the activity's cost to the hunter. These factors, as well as distance of travel and unfamiliarity of the species, may be responsible for the lower hunter demand relative to other game ungulates. Ross reported that the number of hunters willing to participate in antelope hunting were less than that for other big game species. Since Ross' report and especially over the past decade, licence allocations have increased but demand has not grown at the same rate, as measured by Big Game Draw applications (Figure 16; Appendix XIV). However, this annual demand has been sufficient, for the most part, to meet these allocations and, as was witnessed in the past, can be increased somewhat through public advertisements to hunters, changes in season structures and new licence marketing strategies.

Table 6. Demand for licences and created recreation days by antelope hunting in Saskatchewan, 1973, 1980 to 1990, inclusive[a].

Year	Licences Issued	Big Game Draw Applicants	Percent of Applicants Successful in Acquiring a Licence	Recreation Days	Recreation Days per Hunter
1973[b]	2,805	N/A	N/A	5,154	1.8
1980	2,194	N/A	N/A	3,515	1.6
1981	2,395	5,099	47	3,753	1.6
1982	2,554	5,734	45	3,920	1.5
1983	2,411	5,430	44	3,955	1.6
1984	2,717	N/A	N/A	3,785	1.4
1985	2,921	N/A	N/A	4,842	1.7
1986	2,983	N/A	N/A	5,180	1.7
1987	3,461	4,403	79	6,176	1.8
1988	4,346[c]	5,130	85	8,087	1.9
1989	5,014	6,453	78	9,214	1.8
1990	6,426	7,584	85	12,589	2.0

[a] Statistics for rifle hunting, only.
[b] As reported by Ross (1973).
[c] 204 licences not sold.

As mentioned, a core number of Saskatchewan hunters have been, and will continue, to participate in pronghorn antelope hunting. The fact that many have to travel great distances says much for the desirability and, therefore, social benefit of this species. However, if more licences are to be allocated in the 1990's and these licences are to be sex and age specific, two events in demand must occur. First, existing demand (the long-term antelope hunter) must be utilized more effectively in obtaining population and management objectives for antelope. Second, new hunters will have to be recruited and sustained through different forms of incentives to make up for the quota disparities not filled by existing antelope hunter demand.



Missing data extrapolated: refer to Table 6.
Note spread in late 1980's applications compared to early 1980's.

Figure 16. Licence sales versus Big Game Draw hunter applications.

Economic Impact

Hunting in general has a sizeable economic impact on the economy of Saskatchewan, $42.3 million in expenditures in 1987 (Filion et al., 1990). Benefits descend to service industries in rural Saskatchewan where influxes in seasonal cash flows are important for the economic well-being of these small businesses and to the rural community at large.

Pronghorn antelope hunting contributes its share to the provincial economy. Crouter (pers. comm.) calculated that the average big game hunter in 1989 spent approximately $118.00 per day participating in the sport. In that year, 5,391 either-sex licences were sold and 10,883 hunter-days generated by antelope hunting[2], thus total hunter expenditures in the province equalled approximately $1.3 million (Appendix XV). This disbursement of monies further resulted in a secondary round of spending of more than $0.6 million and created 24.5 person years of employment. Total provincial output, therefore, reached close to $2.0 million dollars in 1989.

Crouter further projected the economic impact of a non-trophy antelope season with a demand for 5,000 licences in addition to the regular either-sex season. The financial repercussions meant that an additional $1.8 million and 22.9 person years of employment would be produced with this new hunting season (Figure 17; Appendix XV). Projecting these 1989 figures to 1991 dollars and possible 1991 either-sex and non-trophy licence quotas, antelope hunting will produce a provincial output of approximately $4.4 million and create 48 person years of employment.

However, Crouter cautions that the non-trophy portion of this output may not entirely represent new economic activity within the province as these non-trophy antelope hunters may well have spent this money on hunting other wildlife species or recreational activities. Only the expenditures of new hunters from outside the province or Saskatchewan hunters that would have spent their recreational dollars outside the province in the absence of this hunting opportunity can be considered as new economic activity. Furthermore, if regular either-sex hunters are given the opportunity to hold both an either-sex licence and a non-trophy licence, and are able to hunt in the same time period, then Crouter's projected additional provincial output may be considerably less than quoted.

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[2] Includes archery hunting activity.

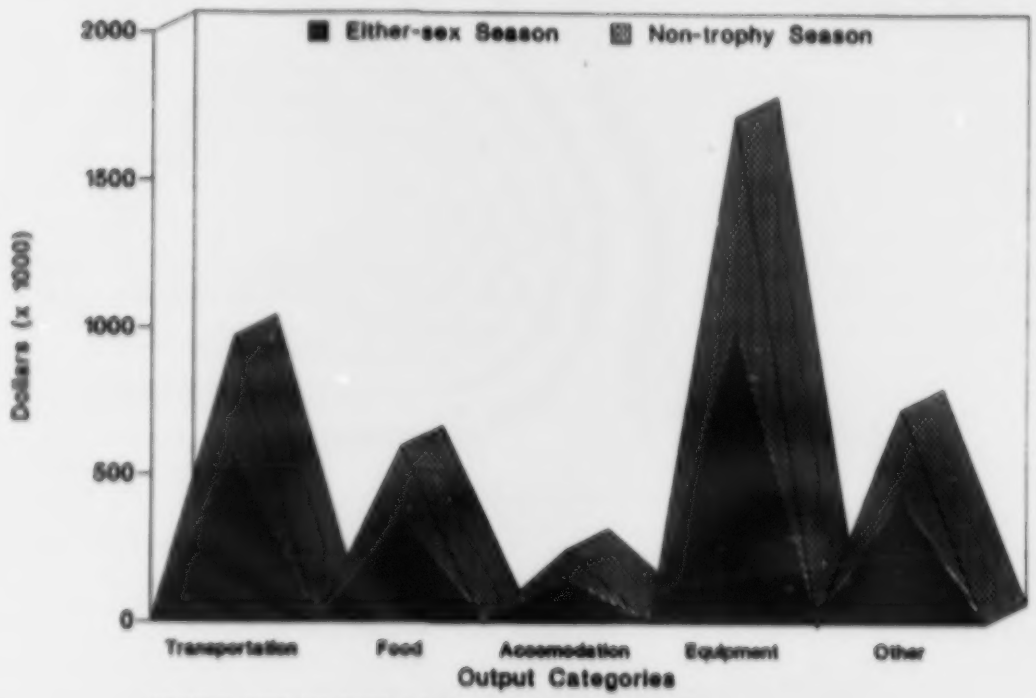

Figure 17. Potential economic output derived from pronghorn antelope hunting in Saskatchewan, 1991.

Public Attitudes

Hunter Questionnaire

Methods

On July 10, 1990 a questionnaire (Appendix XVI) was sent to 590 pronghorn antelope hunters who were drawn for the 1989 antelope hunting season. The questionnaire was accompanied by a letter outlining the present population status, depredation concerns and the need for new management strategies to balance herd numbers in relation to the demands of landowners and hunters. The letter also introduced the concept of non-trophy antelope seasons, non-trophy being defined as "**A female or male pronghorn antelope having horns not more than 7.6 cm (3 inches) in length**". Hunters were requested to return the questionnaire by August 11, 1990.

Hunters were asked whether or not they would participate in a non-trophy season. If willing to participate, they were then questioned as to the importance of such elements as availability of licence, increased bag limit, involvement of young hunters, date of seasons, combination with other big game species and licence price. Finally, hunters were asked to chose one of four season structure options, the fourth being their suggestion, which would best fit their preference.

Results and Discussion

Eighty-three percent (83%) of the 289 hunters that returned their questionnaire stated that they would be willing to participate in a non-trophy antelope season (Appendix XVI). Availability of the licence was important for the majority, however, there was not a clear-cut preference whether or not the licensing system should still remain within the Big Game Draw system. Close to half (45%) of the hunters sampled wanted the opportunity to harvest more than one non-trophy animal. When asked the importance of increased involvement of young hunters under the age of 16 years, 50 per cent thought it important, 19 per cent thought it of little importance and 31 per cent stated it was not important.

Either-sex antelope seasons are presently 2½ to 3 weeks long, depending on the calender year, to allow hunters who have to travel a long distance the opportunity to harvest both a mule deer and antelope, if drawn, on the same hunting trip. When asked the importance of a combined non-trophy antelope season and another big game season, such as antlerless mule deer, 76 per cent responded that it was important.

The current licence fee for an either-sex antelope licence is $35.00. In addition, a $10.00 Habitat Certificate is required by all hunters in Saskatchewan to validate any of their game licences. When asked the price of a non-trophy antelope licence in comparison to the either-sex licence, 65 per cent of the respondents indicated that the non-trophy licence should be reduced. The average suggested price was $18.96 with $20.00 being the prevalent price quoted.

The questionnaire contained three queries as to the timing of the non-trophy season. When asked if the season should be held during the either-sex season, 60 per cent thought it was important to do so. Responses to the question that the non-trophy season be held after the either-sex season were mixed, 33 per cent said it was important, 29 per cent said it was of little importance and 38 per cent said it was not important. Thirteen percent (13%) of the hunters which answered both questions indicated that it was important to have a non-trophy season during and after the either-sex season. Finally, the majority of the respondents (42%) preferred a non-trophy season structured where there was a total overlap of dates with the either-sex season and either-sex licence holders could also hold a non-trophy licence.

In summary, we felt that the majority of antelope hunters were requesting a non-trophy pronghorn antelope season where:

1. Licences were easily obtained such as over-the-counter sale.

2. Bag limits were increased.

3. Hunters under the age of 16 could obtain a licence.

4. Other big game species could be hunted on the same hunting trip.

5. Licence fees were less than either-sex licences, $20.00 being the most popular price.

6. Season dates were the same as the either-sex season and either-sex licence holders could obtain a non-trophy licence.

Conservation Officer Opinion and Enforcement Implications

Conservation officers in the Swift Current Region were asked their opinions on a non-trophy antelope season and its possible structure. All officers supported the concept of such a season and the majority felt that the either-sex and non-trophy season dates should be concurrent. Most of the officers felt either-sex licence holders should be given the opportunity to also participate in the purchase of non-trophy licences.

The officers' consensus on a legal description for a non-trophy pronghorn antelope favoured Alberta's characterisation, that is, "**A female or male having horns not more than 7.6 cm (3 inches) in length**" in light of our late season and horn drop. The officers and PAMP authors feel the proposed non-trophy season is flexible enough to allow for honest mistakes, that is, the taking of yearling bucks and should cause few enforcement problems.

We received a mixed response on how best to distribute the licences. Some officers felt the over-the-counter system was best while others wished to see distribution remain in the Big Game Draw.

Of interest was the similarities in season structure preferences between the two sample groups, Conservation officers and hunters. It appears that both groups have formulated convergent views on how non-trophy antelope seasons should be managed for the benefit of the user and the law enforcer.

Concerns of Landowners

Unlike the antelope hunter and Conservation officer, landowners were not surveyed by way of a questionnaire or letter. The brief summation on landowner attitudes contained within this section was obtained from SNR Occurrence Reports, depredation claims and casual conversations with affected landowners by a number of SNR staff members. As a result our conclusions may be quite subjective and biased by our own attitudes or influenced by those of the most outspoken landowners.

The general impression we have gathered is that a proportion of southwest Saskatchewan landowners are anxious with the present number of antelope they are observing within the region and, more specifically, on their land holdings. Concerns have escalated the past number of years and have been fuelled by factors such as:

1. A series of mild winters with little or no snow cover which exposes and enhances the utilization of some agricultural crops (eg. fall rye) by antelope year round.

2. Drought conditions and poor markets for conventional produce has brought about agricultural diversification of crops. In some cases, these new crops (eg. lentils and field peas) are highly attractive to antelope as a primary food source.

3. Weak agricultural markets have resulted in a depressed farm economy, thus, government assistance programs, like the Wildlife-Landowner Assistance Program, are much more significant to the farming operation.

Concerns regarding the antelope population were reflected in the number of recorded complaints[5] received by SNR district offices (Table 7). Many involved the frequency at which they encountered antelope and were not substantiated depredation claims. However, authentic depredation claims and compensation pay-outs have increased over the past few years. We believe this was sufficient evidence to conclude antelope depredation is real and on the rise due to high populations.

We suspect that landowner attitudes toward antelope numbers is part of a much broader issue, that is, the growing number of all big game populations and the affinity these populations have toward agricultural produce. Not all landowners in southwest Saskatchewan perceive antelope as a problem species, but those that do have generated considerable political momentum for the creation of new population objectives much lower than what is presently occurring in the region. This is not to say landowners advocating lower antelope populations are not justified in their demands, but we wish to make it clear that these demands may be just as much a part of perception and economic times, and the false conclusions that they may lead to, as real losses to antelope depredation.

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[5] Some complaints may not have been recorded owing to minor crop damage or the contact may have been treated as a landowner inquiry regarding department damage prevention/compensation programs.

Table 7. Antelope depredation complaints as recorded by conservation officer occurrence reports, 1986-90.

	Year			
WMZ	1986-87	1987-88	1988-89	1989-90
2	2	3	1	1
4	2	2	1	
5	3	1	4	8
6		2	3	4
7				2
8	1		6	2
9		1	1	3
10	3	4	8	6
11	3	1	1	
12	1			
13	1	2	3	8
14	1	1	2	2
19				1
25		2	2	
26	1	1	1	
27	1		1	1
unk.[a]		1	2	
total	21	21	36	42

[a]unk. - WMZ origin unknown.

Depredation

Crop damage by antelope in southwestern Saskatchewan has likely existed for a number of years on developed lands which are in close proximity to traditional native range. Damage may have been minimal in that it went undetected or had no real economic impact on the landowner.

Authors such as Dirschl (1960a), Mitchell (1980) and Pyrah (1987) have recognised antelope depredation but much of this foraging was in relation to seasonal diet changes when other more preferred native vegetation was not available. A prime example is the use of fall rye crops by antelope. This use may be a transitional food source as antelope diets switch from forbs to shrubby species in the autumn and shrubs to forbs in the spring. However, in certain cases, we have recorded use throughout the entire winter when snow depths are minimal and antelope do not appear to switch to shrubby vegetation as the primary food source. Both Banfield (1974) and Pyrah (1987) state that antelope diets are consistently comprised of small amounts of graminaceous material, however, Mitchell (1980) found a higher percentage of use of grasses in Alberta than the previous two authors.

Throughout our June, 1990 survey effort, we recorded observations on the number of antelope seen in summerfallow as compared to crop fields. Although spring planted wheat was most succulent at this time, antelope did not appear to be selecting for these cultivated grains, at least no more than for herbaceous vegetation on summerfallow, and much less so than for lands with greater amounts of native habitat. Our conclusion was based on the inability to detect any significant (Ps 0.05) difference in mean values or occurrence between the two habitat types, although we do recognize we were viewing these animals at only one point in time. When flying the surveys, we assumed that early morning and evening should have been at a highly probably period for food procurement and the animals would occur on feeding areas. The fact that antelope did not appear to be selecting for spring-planted graminaceous crops puts in question the validity of late spring-early summer depredation claims made by some southwest landowners. As mentioned, Pyrah (1987) found that antelope use of grain crops was low throughout the year on his Yellow Water Triangle study area while Hnatiuk's (1976) four year (1969-72) examination of year round antelope occurrences on different habitat types revealed that on lands which were actively cultivated, antelope were observed more frequently on summerfallow or stubble than on spring wheat. The one exception was for the month of June when observations favoured seeded crops although we found no evidence of this in our June, 1990 surveys.

Regardless of our findings, we recognize that antelope do occur at some level of frequency on seeded spring wheat fields and do cause a certain level of damage. Depredation, at any level, now plays a much larger role because of the economic impact on the "strapped" farming or ranching operation. A number of causes such as increased land development adjacent to native habitats, higher wildlife populations on a steadily declining habitat base, and crops becoming more attractive to numerous wildlife species have had the effect of increasing depredation. This last point, crops becoming more attractive, was explained by Pyrah (1987) as an ability of antelope to utilize a wide range of plants and, thus, enables them to occupy and adapt to nearly all of the habitat available.

Public displeasure and cost to government for antelope damage has steadily increased since 1983 (Figure 18; Appendix XVII[a]). That year, SNR's Wildlife-Landowner Assistance Program paid on two claims which amounted to $2,613.00. In 1990, forty (40) valid claims were received with a compensation pay-out authorized at $37,929.00[b]. This cost may represent a fraction of the true loss to the landowner as under the program's compensation formula, maximum pay-outs are $50.00 per acre to a total annual pay-out of $2,500.00. Lower than actual loss compensation further influences landowner tolerance toward antelope and ultimately influences wildlife management practices.

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[a]The sudden drop in 1989-90 claims and compensation could not be readily explained by data available to the authors. It may have been a residual effect of the severe drought in 1988-89 where soils were too dry to plant speciality crops such as lentils and field peas. Delaying some claim pay-outs until the following budget year may also explain a part of this variation between 1989-90 and 1990-91.

[b]Some damage claims consisted of both antelope and deer damage to field crops. Damage by each species could not be differentiated, therefore, the cost of antelope depredation was actually somewhat less than presented in text and Figure 18.

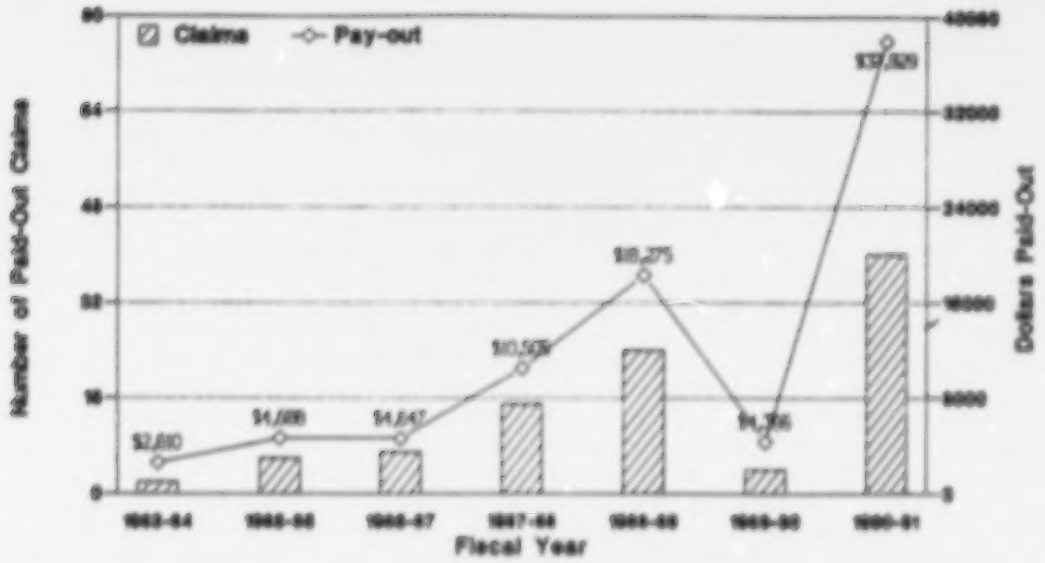

Figure 18. Number of paid-out claims and cost, 1983-91.

Recommended Management Objectives and Strategies

Population and Harvest

Objectives

The history of Saskatchewan's pronghorn antelope management has been influenced by three major factors which are in continual flux. First, herds can be quite migratory, tending to move from WMZ to WMZ or in and out of the province. This movement is usually triggered by winter conditions and the pattern is very complex (Hnatiuk, 1976). Range quality and weather patterns prior to the hunting season, are also thought to have contributed to antelope movement out of more agriculturally developed WMZs into areas with better range conditions (eg. from WMZ 4 and 5 to WMZ 2; from WMZ 24-29 to WMZ 14). Second, we partially share this resource with Alberta and Montana. Their management practices have had and will continue to have an impact on Saskatchewan's strategies. Third, antelope, particularly fawns, are very susceptible to both weather related mortality and predation. As is the usual case for a wildlife species at its northern range limit, this has had the greatest effect on population stability and presents significant challenges for wildlife management practices.

Regardless of these variables and the difficulties they may introduce in meeting short-term goals, we recommend that the department strive for a 1991 provincial post-season population of 15,000 antelope at a herd structure ratio of approximately 25 bucks per 100 does per 80 kids. If successful, the provincial population will decline by approximately 25 per cent at the end of the 1991-92 winter (Appendix XIII).

In order to meet the above objective, present harvest efforts must be intensified and be more selective toward the removal of reproductively prime females. We recommend the creation of a doe-fawn or "non-trophy" season as a tried-and-true method to accomplish rapid and sustained population reduction. Because antelope occur at different density gradients throughout its Saskatchewan range (Figure 4) and depredation concerns do not always follow this same density pattern, these non-trophy harvest strategies must be very selective from WMZ to WMZ.

1. Core Population[a]

Population objectives for each WMZ (Table 8) were developed primarily on the basis of landowner concerns regarding depredation and/or perceived competition with livestock. The magnitude of the proposed harvest strategies were dependent upon previous hunter success, aerial survey estimates of population size and the amount of native range remaining in a particular WMZ. For example, we are proposing a higher harvest level relative to the total population for WMZ 6 than for WMZ 3. The objective in WMZ 6, where there is a large proportion of agricultural land and prominent landowner concerns, is to reduce the population while in WMZ 3, primarily native range, the objective is to stabilize the population.

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[a]The term "core" refers to that area south of Dirschl's (1968a) antelope range boundary (Figure 4) and contains approximately 98 per cent of the provincial population.

Table 8: Estimated pre- and postseason population, population objective and licence allocations by wildlife management zone[a].

WMZ	June, 1990 Population[b]	1990 Pre Season Population[c]	1990 Post Season Population	1991 Pre Season Population[c]	1991 Licence Allocation Either sex	1991 Licence Allocation Non-trophy	1991 Post Season Population	Post Season Management Objective
1	870	1,210	1,020	1,350	200	250	960	900
2 & 5	8,580	12,660	11,440	15,760	1,500	2,290	10,000[d]	5,700
3	3,620	5,060	4,010	5,143	800	860	3,620	3,600
4	810	1,100	920	1,200	250	300	670	600
6	1,820	2,280	2,050	2,930	500	600	1,890[d]	1,000
7	1,670	2,190	1,750	2,510	400	600	1,570	1,500
8 & 11	1,930	2,670	2,210	2,890	500	600	1,860[d]	1,500
9	1,700	2,380	1,640	2,310	500	600	1,260	1,200
10	990	1,370	810	1,100	200	250	670	700
12 & 13	980	1,360	990	1,310	300	300	750	700
14 & 24-27	1,560	2,190	1,720	2,260	300	400	1,600	1,300
18, 19 & 23	610	840	700	930	150	200	570	400

[a] WMZs in which antelope hunting is allowed.
[b] Before the 1990 kid production.
[c] Including kid production and pre-season mortality.
[d] Management objective met after 1992 season.

In other zones (eg. WMZ 2), very large antelope populations requires different management strategies. Concern for potential conflicts between landowners and vast numbers of hunters has meant population objectives will not be met until 1992 or 1993. However, a significant herd reduction will occur in 1991 which will help alleviate landowners concerns.

The licence allocations presented in Table 8 are conditional on "normal" winter conditions in 1990-91 and average fawn production in the spring of 1991 (pre-season ratio of approximately 67 fawns per 100 does). If hunter success rates remain comparable to that of the past decade, approximately 40 per cent of the pre-season population will be harvested in 1991.

Projections for harvest structure in both the either-sex and non-trophy season are somewhat obscure, therefore, "fine-tuning" of harvest strategies will be necessary once more accurate information on age and sex selection becomes available. Based on current data, we were able to project a 1992 to 1995 annual licence quota in the core area of approximately 3,500 either-sex licences and 1,500 non-trophy licences, however, a multiplicity of variables will effect this forecast.

ii. Fringe Population

Fringe herds should be allowed to maintain their present population levels and in some cases be given the opportunity to grow. Although consumptive use and hunting recreation of these herds is limited, we should not overlook the importance these groups have to the non-consumptive user. As antelope expand and grow in Farmland zones, they are considered an anomaly to the area and are valued for their aesthetic benefits.

The management objective of population maintenance or growth is recommended for fringe populations (Appendix III). This will address the wishes of both user groups as long as environmental conditions allow these herds to exist.[8] Licence allocations will be conditional on harvestable population levels and restricted to either-sex licences, only. Some of these fringe WMUs are presently combined to account for antelope movement from WMU to WMU and will remain so in the attempt to maintain quality hunting opportunity.

iii. Summary

The recommended harvest objective for both the core and fringe populations combined is one which tries to reach 15,000 animals by the end of the 1991 hunting season. Although there is a potential to have

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[8] The present occurrence of antelope in many farmland WMUs is thought to be a result of a series of mild winters. Like deer in the northern forest, a return to more severe winter conditions will seriously reduce herd numbers.

as many as 11,850 hunters afield in 1991 and antelope hunting has had a history of hunter-landowner conflicts in Saskatchewan, a number of SNR staff feel that landowner concerns regarding all big game depredation is such that a large, one-time influx of antelope hunters would be tolerated. New initiatives (strategies) in season structure will also help alleviate concerns of landowner-hunter or hunter-hunter conflicts by allowing hunters to hold more than one antelope licence and by spreading the hunting pressure over a longer period of time. These initiatives are outlined in the ensuing pages.

Proposed Non-trophy Season Strategy

Season

As stated, to obtain population and herd structure objectives we feel it essential that Saskatchewan introduce a "non-trophy" antelope season in which the major component of the harvest is adult females. Other juriedictions, such as Wyoming (Harju, pers. comm.) and Montana (Mule, pers. comm.), define a legal non-trophy animal similar to Saskatchewan's definition of antlerless deer, that is, an adult female or a fawn of the year. They have found that the key identification features of a black face and prominent horns sufficient for hunters to distinguish between the sexes of adult animals. However, these juriedictions normally hunt their antelope considerably earlier than Saskatchewan and, therefore, the annual shedding of horns by adult males is not an identification problem that their hunters have to contend with.

Alberta's non-trophy season dates are closer to our own either-sex season, usually starting the third week of October. Their definition as to what constitutes a legal non-trophy animal is "A female or male pronghorn antelope having horns not more than 7.6 cm (3 inches) in length". This type of season has been in existence for approximately 10 years in Alberta and no major problems have resulted in the use of this definition (Gudmundson, pers. comm.), that is to say, the number of accidentally shot mature bucks has been small. Therefore, we recommend that SHR adopt Alberta's non-trophy definition which will allow Saskatchewan hunters, who will be experiencing this type of season for the first time, ample leeway to accidentally harvest yearling males that have shed their horn sheathes.

Structure

As previously mentioned, to meet the 15,000 post-season population objective, 11,650 licences will have to be allocated.[F] If this licence quota equated to an equal number of hunters, we feel there could conceivably be more hunter-hunter and landowner-hunter conflicts than what "normally" occurs owing to the sheer number of participating hunters in a short time frame. This, in turn, may impact negatively on future hunting opportunity (eg. land access, hunter interest, etc.) as well as on the public image of the department. There is also the question of whether or not Saskatchewan has enough hunters willing to part take in hunting antelope. Over the years we have already witnessed declines in the number of big game hunters, and interest in non-trophy seasons, such as those for mule deer and white-tailed deer, has always been difficult to incite. In order to mitigate potential problems or shortfalls in licence sales, it is our recommendation that:

[F] Projected licence quotas are conditional on winter (1990-91) and spring (1991) weather patterns similar to those experienced over the past decade.

1. Either-sex antelope licence holders be given the opportunity to also hold a non-trophy licence.

2. A hunter may purchase up to three non-trophy antelope licences.

3. The price of these non-trophy licences be no more than $20.00 a piece.

Each one of these recommendations were based on present licencing systems within other North American authorities. It must also be noted that these are preferences which Saskatchewan hunters identified in the questionnaire sent July 10, 1990. Finally, this will reduce the number of hunters afield at one time as we expect that either-sex licence holders will make up a significant proportion of the hunters willing to participate in a non-trophy season.

Timing

In Wyoming, where more pronghorns are harvested annually than in any other state or province, the either-sex and doe-fawn seasons run concurrently. Closer to home, Alberta overlaps their non-trophy three days following the start of the trophy (buck) season. This allows trophy hunters some time to themselves before the other group is also in the field. Both authorities reported few complaints with the overlap of seasons (Gudmundson, pers. comm.; Harju, pers. comm.).

The majority of Saskatchewan hunters polled on the question of overlapping either-sex and non-trophy seasons stated it was important (Appendix XVI). When asked to chose a season structure, the bulk chose a non-trophy season where season dates were the same as the either-sex season, that is, no special preference in season dates granted to either-sex hunters.

Based on the experiences in Alberta and Wyoming, and the expressed wishes of the hunters sampled in this province, it is our recommendation that the non-trophy antelope season overlap the either-sex season dates. As mentioned, this would allow for hunters with both licence types the opportunity to utilize them on the same hunting trip. In addition hunters who were unsuccessful in the either-sex draw or who were too young to apply for the draw would have the opportunity to join friends or family already heading to southwest Saskatchewan to hunt antelope.

In Combination With Other Big Game Seasons

The either-sex antelope season dates were lengthened in 1987 to allow hunters the chance to harvest an antelope while hunting mule deer in November. The intention was to increase recreation potential while on the same hunting trip. The department has received a number of positive comments by hunters for this extended opportunity. Results from the July 10, 1990 survey (Appendix XVI) indicated that this policy was still favoured by hunters. Therefore, we recommend that the non-trophy antelope season overlap not only the either-sex antelope season but also all mule deer and white-tailed deer seasons in units where non-trophy antelope licences have been allocated.

The proposed overlap with the either-sex and antlerless mule deer seasons is not a radical change from our present antelope hunting system as antelope hunting already occurs on those dates. Controversy may arise, however, with the further extension of the non-trophy season into the white-tailed deer season.

Except for the Commercial Forest, Saskatchewan's policy has been to not allow other hunting seasons to overlap the whitetail season while it is in progress. However, events over the past decade have meant that whitetails in southwest Saskatchewan have increased to a point where hunting pressure from local residents have had little impact in stabilising population growth. In a number of WMAs, the department continues to try to stimulate interest in hunting antlerless white-tailed deer but with mixed success. The recommended overlap in WMAs where non-trophy antelope licences have been apportioned may create new interest in southwest Saskatchewan whitetail hunting, but just as importantly, it will be a convenience for hunters who have already established a pattern of going to that region of the province.

We feel that in order to maintain or increase hunting interest, two important factors must be built into any hunting season proposal. First, the season must be as simple as possible with the least number of "twists" to confuse the hunter. Second, the season must be cost-efficient in order for the hunter to continue to participate. "Gimmicks" are fine for one or two years, but if the seasons remain complicated and expensive, interest will soon wane. The above recommendation to overlap seasons is simple to comprehend in that the non-trophy season will have set dates which happen to coincide with conventional big game seasons and it is economical for the hunter wishing to bring home more than one big game animal.

Licence Distribution

We recommend the sale of non-trophy licences be delayed until after the Big Game Draw results have been announced. Hunters who have been unsuccessful in the draw for other more preferred big game licences may be more apt to purchase one or more non-trophy antelope licences once they know they will not be hunting other species. It may also encourage friends or the children of hunters who have been drawn for either-sex antelope to join in the hunt.

The majority of hunters polled in the July 10, 1990 survey (Appendix XVI) wanted over-the-counter sale of the non-trophy antelope licence while there was no clear consensus as to whether or not the licence should remain within the present Big Game Draw system. Ideally we would like to see distribution through some form of province-wide computerized vendor system which would allocate licences based on a WMA by WMA quota. The network system does not exist as of yet and, therefore, the department will have to be responsible for the distribution for the time being.

A variation to the above system would see non-trophy licences, on a first-come, first-served basis being distributed through SPD offices in those WMAs where antelope hunting was taking place. Surplus Big Game Draw and antlerless white-tailed deer licences have in the past been successfully distributed in this fashion. Hunters unable to purchase their licences in person before the

season have reserved licences by telephone and later mailed their money orders or cheques to those SRR offices. Alternatively, hunters have used major credit card numbers to guarantee their licence purchases. The major drawbacks to this system is that it would take considerable administrative co-ordination and staff time while inconveniencing the hunter (ie. SRR offices closed on weekends). It is unlikely that many of the smaller SRR offices have the staffing complement or budgets to take on the sole responsibility of non-trophy licence distribution at this time. In fact, this strategy would only transfer the burden of non-trophy licence distribution from head office to regional and district offices where resources are more limited.

The delivery system recommended is a first-come, first-served telephone selection process co-ordinated in Regina, with no priority pool, and after the Big Game Draw results are available.[20] Hunters will have the opportunity to personally select their WMS choice from a list of WMAs where non-trophy antelope seasons are being offered and with the added benefit of knowing if they have been drawn for other big game seasons. Another benefit the telephone system has over other licensing vehicles is that it affords the hunter the ability to change their WMS choice if their first choice has already been allocated, thus helping to maintain hunter satisfaction and licence sale objectives.

Many Saskatchewan big game hunters have become accustomed to not being drawn annually for a particular species and, therefore, do not bother to apply when still in the lower priority pools. The easy access to a telephone sales system as opposed to filling out entry forms and the fact that hunters could potentially be drawn every year may maintain interest in such a season, again helping to ensure the department meets its antelope population objectives.

Once the time frame for the central telephone sales system has elapsed, we recommend any surplus licence be distributed to SRR District offices in southwest Saskatchewan and sold on a first-come, first-served basis over-the-counter. We feel additional sales, albeit small, will be captured in this manner without undue administrative hardships to District offices.

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[20] Applicants will have an equitable chance of being selected every year. Technical limitations in the number of outside calls the telephone system can handle at one time will mean applicants on the Regina telephone exchange will have somewhat of an advantage over out-of-town callers.

[21] Because their is no ranking, administrative costs and staff time related to priority pool record keeping will be minimal compared to the present Big Game Draw system.

Population Monitoring Strategy

Comparisons were made earlier which demonstrated possible gaps and inaccuracies in the department's knowledge of sex and age harvest structures (Table 5). Past aerial survey efforts have concentrated on blocks with high density populations, thus were limited in scope for extrapolation over other areas. These surveys gave only trend values and were unable to estimate with any precision population sizes. The non-trophy season, if adopted, will have a significant effect on the status of the provincial antelope population. In summary, these impacts, and the impacts of naturally occurring events, will have a profound bearing on how the department manages its antelope resource in the future.

This section identifies where biological information is deficient and makes a number of recommendations to improve the present system which will not tax existing budgets. A systematic schedule of data collection and population modelling by WMZ will be the key to proper implementation.

WMZ Population Models

Models are designed to simulate the dynamics of wildlife populations (Bartholow, 1986) and are especially helpful in projecting the impacts of management decisions on future wildlife populations. In short, models are powerful tools which increase efficiency and effectiveness of management planning.

Throughout North America models are used extensively on a number of wildlife species[8]. Models give the user flexibility in that relatively accurate population estimates for a particular wildlife species can be made without the annual need for expensive data collection procedures like aerial surveys.

Wyoming has in place an extensive modelling program for all its antelope herds within hunting units (Harju, pers. comm.; Christiansen, 1989). Some less intensive data collection programs are conducted annually to keep the model "aligned" while large scale programs, such as population surveys, are cyclic, being spaced two to three years apart.

We recommend SNR follow a pattern of antelope modelling and biological collection similar to Wyoming. Models for each WMZ should be created to implement a more organized approach to antelope management. Present information gathering will have to be modified and new programs created to better meet the needs of the modelling process. However, we are quite aware that these changes will have to fit into the Saskatchewan context, that is, consider our more limited staff and financial resources as compared to other jurisdictions.

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[8] In Saskatchewan, models have been created for white-tailed deer, moose and mule deer but are not in wide-spread use.

Aerial Surveys

I. Population Status

We recommend Line Transect survey blocks be developed for each of the WMIs within the core range (Figure 4). Blocks must cover sufficient area in order to be representative of the land use within that particular WMI. These surveys can be flown at any time of the year for modelling purposes, however, we recommend the late May - early June period for the best dispersal of animals over their range or, at the least, pre-season flights before migration to wintering areas or being scattered by hunting pressure.

Line Transect surveys should be conducted at three year intervals to check population estimates developed in the model. Staggering surveys will result in continuous, but cost-efficient, population estimates necessary in management decisions.

II. Herd Structure

Obtaining adequate sex and age information is important in maintaining an accurate population model. Classification data should be from statistically adequate samples in order to develop the smallest, tightest possible confidence intervals.

It is our recommendation that herd classification surveys should be flown every year and they be representative of populations within the high, moderate and low density areas (Figure 4). Surveys will be exemplary of the total area within a density gradient and samples be of sufficient size in order to obtain precision estimates of ±5 to 10 per cent at P= 0.05.

Mitchell (1980) and Pyrah (1987) found considerable variation in fawn mortality rate from location to location and from year to year. Generally, antelope fawn mortality was highest between birth and 2 to 3 months of age. The degree of impact spring and summer conditions have on fawns is difficult to quantify for modelling purposes, therefore, aerial surveys must be designed so that the most reliable results are obtained in the appropriate biological period. To overcome unknown spring and summer mortality, we recommend herd structure surveys be conducted in the month of September rather than late June - early July[8].

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[8]The June - July surveys were designed to give a measure of certainty on population size and fawn production before completion of the season setting process. However, we do not feel the need for this information is as critical as it was once thought. Most of Saskatchewan's big game species are monitored in the mid-winter months before the onslaught of winter and pre-season mortality. Wyoming conducts their herd structure surveys just before the hunting seasons (Christiansen, 1989), yet, season proposals and licence allocation are developed long before this survey is initiated.

III. Budget

The staggering of surveys and the use of population models will not result in significant increases in the present monies allocated to provincial antelope surveys. Approximately $5,000 to $7,000 are allocated to current surveys. We recommend no change in this allocation.

Check Stations

The department operated pronghorn antelope check stations off-and-on from 1957 to 1978. Information on animal selection (harvest ratio) by hunters and the age structure of the antelope population by WMS were obtained from these check points. Maybe just as important was the contact department staff had with its primary client group - the Saskatchewan hunter.

We recommend SNR re-establish antelope check stations to acquire more accurate information on harvest ratios for the either-sex season and, most importantly, the non-trophy season. Table 5 has already demonstrated considerable variation in the past between the sex and age of "checked" antelope as compared to reported ratios in the Big Game Hunter Questionnaire. Pyrah (1987) revealed that the number of fawns reported on the hunter questionnaire in the Yellow Water Triangle area in Montana was only 3 per cent while check stations recorded fawns to be 20 per cent of the hunter harvest. Therefore, check stations would be beneficial in clearing up these contradictions and will help maintain factual models.

I. Operation

Our recommendation is to allow private interests to operate antelope check points. This system has worked well for white-tailed deer, moose and elk in Saskatchewan and at a cost saving to the department. A few strategic points in the southwest portion of the province would be sufficient to ensure adequate sample collection.

The proposed 1991 season with its either-sex and non-trophy components, will harvest approximately 9,900 antelope. At $5.00 a sample, payments to private check point operators would financially cripple the department's population monitoring program. To prevent this over-expenditure, we recommend department staff operate the check stations the first three days of the rifle season[2] in 1991 and possibly in 1992. Introductory handling of the stations by SNR would also be beneficial in the first-hand contact with hunters and their reaction to the new PAMP. Responsibility for check station operations would be turned over to private interests in 1993.

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[2]Approximately 70 per cent of rifle hunters have completed their antelope hunt within the first three days (Bilton et al., 1982 - 1989).

8. Budget

Sample collection by privatised check points after the initial high harvest year(s) is estimated to be 1,000 samples, but may run as high as 2,000 depending of the reaction of hunters to promotion programs (eg. major prize draws and lapel pin give-aways presently offered in the Wildlife Co-operator Awards Program). The lower limit (1,000) was based on past ratios of check station samples to total antelope harvest and projected harvests for 1992 to 1995. At $5.00 a sample, expected expenditures would be approximately $5,000 to $10,000, a significant amount considering present day budget constraints.

Possible alternatives would be to offer private check station operators less money per sample than for other big game samples, place a quota on the number of samples to be collected, collect samples every other year or allow interested parties to bid for the right to collect biological samples. The business created by hunters is a seasonal, but significant, economic force for small town Saskatchewan. Entrepreneurs may be very interested in acquiring the rights to collect biological samples and the hunter traffic that accompanies it.

An additional cost in check station operations will be the ageing of mature antelope by cementum annuli. Presently, the department uses the services of a private laboratory to prepare elk incisors and estimate the age of the animal collected. However, the actual number of antelope incisors that need to be sent to the lab would be only 25 to 30 percent of the collected sample[6]. Because the age of an antelope up to 3½ years is easily ascertained by tooth eruption, most of the aging can be handled by SNR staff.

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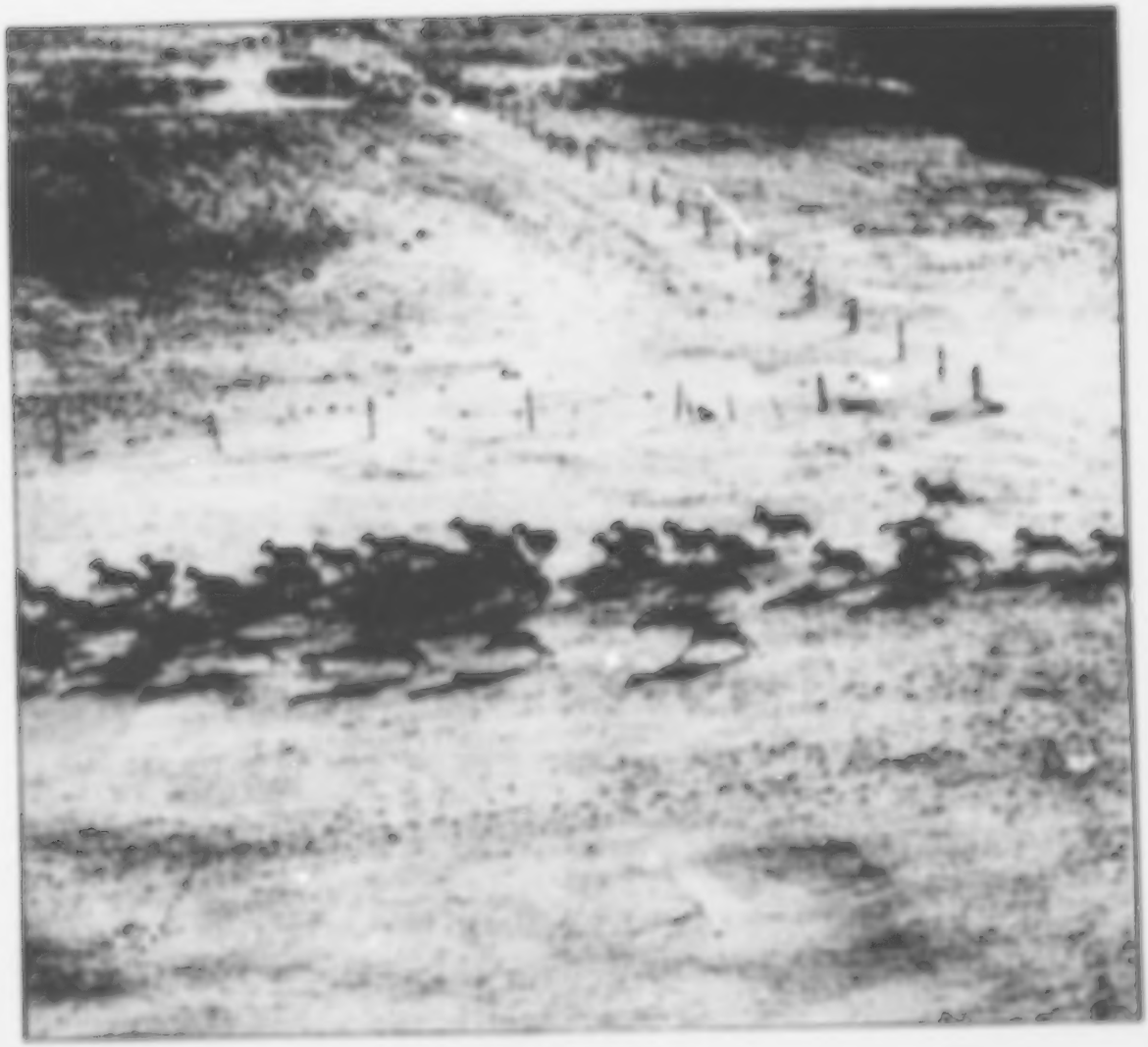
[6]1991 estimated cost $2,500; 1992-95 estimated cost $600.

Communications Strategy

The rationale for the PAMP must be communicated to the public. Most hunters can be reached through information vehicles such as the Big Game Information Sheet, the Hunting and Trapping Guide, and articles in hunting magazines, newspapers, radio and television. However, many individuals in the one group which is advocating lower antelope populations - landowners - will be missed if the PAMP message is restricted to the above information mediums.

We recommend the department publish a pamphlet which would summarize antelope biology, historic management practices, present population status, depredation, and the department's future population and management goals. The pamphlet would be for free distribution at SMR offices and would contain information of interest to landowners, hunters and non-consumptive users.

Summary of Management Objectives and Strategies



The strategies developed to meet objectives recommendations presented in this technical report are listed below for ease of reference. They are catalogued in the order they are found in the text. Most of the minor objectives/strategies (•) are conditional on the implementation of more predominant objectives/strategies (•).

I. Population and Harvest

Objective

- 1991 provincial postseason population of 19,000 pronghorn antelope.
  - Postseason herd structure ratio of 25 bucks to 100 does to 60 kids.
- Manage for population maintenance or growth in fringe herds.
  - No season or, if population warrants, either-sex season, only.

Strategy

- Create a non-trophy antelope season.
  - Definition of non-trophy animal: "A female or male pronghorn antelope having horns not more than 7.6 cm (3 inches) in length".
  - Either-sex antelope licence holder may purchase non-trophy licence(s).
  - A hunter may purchase up to three non-trophy licences.
  - Price per licence no more than $30.00.
  - Non-trophy season dates coincide with the either-sex antelope season dates.
  - Non-trophy antelope season dates overlap other big game seasons, such as, mule deer and white-tailed deer.
  - Non-trophy licence sales after the results of the Big Game Draw are available.
  - Sales by telephone co-ordinated from Regina office. Surplus licences sold over-the-counter at District offices in southwest Saskatchewan.
  - No priority pool - first-come, first-served.

II. Population Monitoring

Objective

- Precise, yet cost-efficient system of monitoring antelope populations.

Strategy

- Future management strategies will be assisted by population modelling.
  - Population models for each WMS.
- Line Transect survey blocks, used to estimate population sizes, be developed for each WMS.
  - Flown at three year intervals, preferably in late May - early June, but at least before the hunting season.
- Herd classification surveys flown annually.
  - Surveys conducted in the month of September.
- Re-establishment of antelope check stations.
  - EMR operated check stations in 1991.
  - Privately operated after 1993.

III. Communications Strategy

Objective

- Inform public of change in provincial antelope management.

Strategy

- Inform hunters of changes in antelope management through EMR information sources and the press.
- Publish information pamphlet on antelope management objectives for free distribution to landowners, hunters and non-consumptive users.

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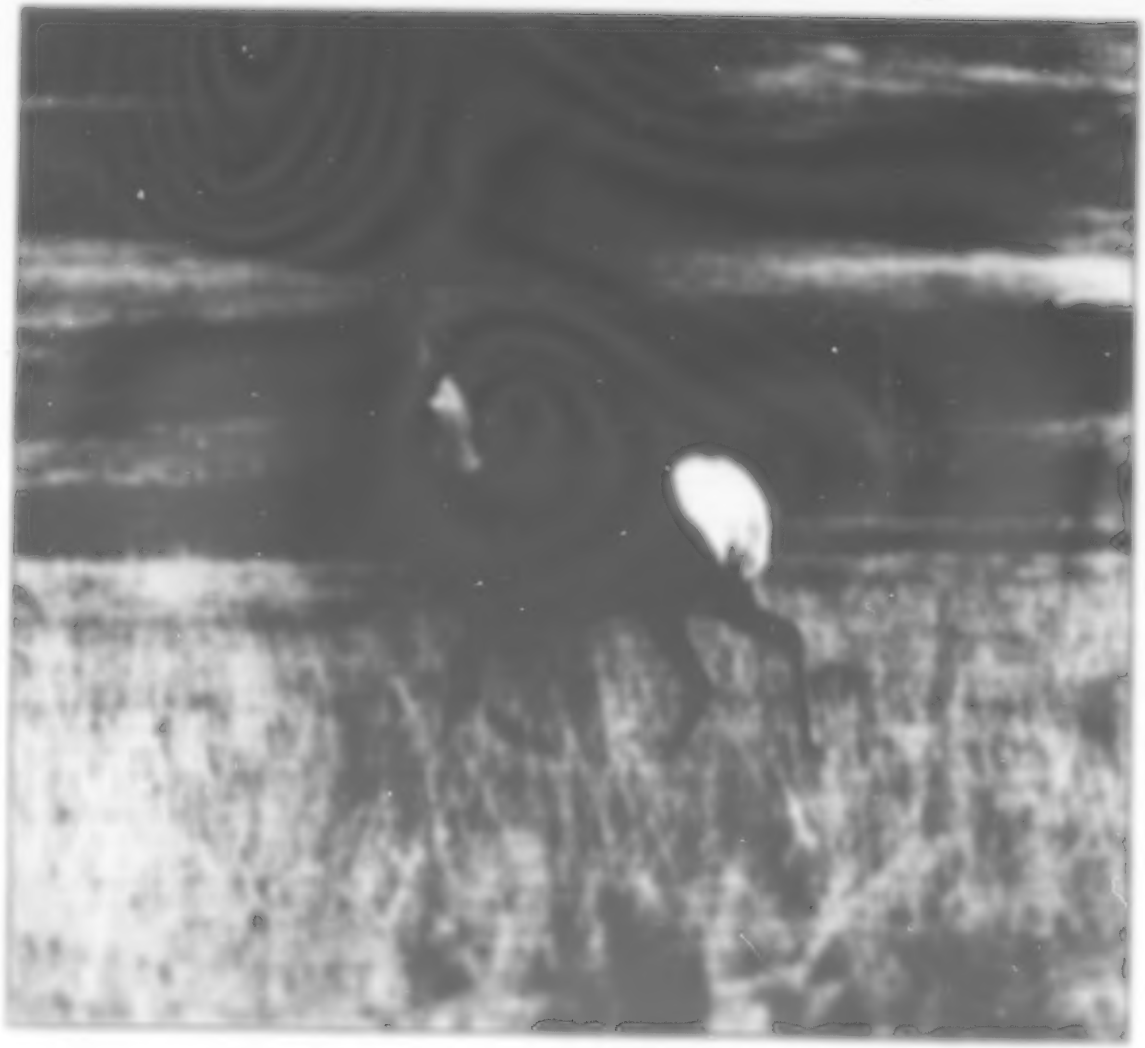
Appendices



Appendix I. Historic status reports of pronghorn antelope management in Saskatchewan, 1898-1990.

Year	Commentary
1898	Considerable discussion in press re: protection of game. The Game Ordinance already in existence but Game Guardians asked to comment on the establishment of hunting licences and seasons (Aug. 1 to Dec. 31).
1899	Game Guardians issued 20 resident game licences and nine guest licences in the Territories (Alberta & Sask) in 1899. Complaints re: roaming Indian bands killing large number of big game.
1900	Game Guardians issued only 10 resident and six guest game licences in 1900. Complaints re: roaming Indian bands killing large number of big game.
1901	Only seven game licences issued - no guest licences applied for. Reference to a great deal of illegal harvest by "land seekers" (homesteaders). Reference to prairie fires in the Little Bow country driving antelope east to Medicine Hat area where the Indians made a great slaughter of them. Complaints re: roaming Indian bands killing large number of big game.
1902	Only 19 game licences issued but reports that purchase of licence being ignored, however, investigation revealed no evidence to convict. Newspaper reports of shooting matches between two sides where all manners of birds and beasts were killed on a fixed day. Complaints re: roaming Indian bands killing large number of big game.
1903	Seventeen (17) game licences issued to non-residents. Change in law protecting the females in the deer family. Ignorance of the game law is much more common than a knowledge of it.
1904	Eighty (80) non-resident licences issued - only two general resident licences were issued. Antelope becoming scarce as settlement advances.
1905	About Last Mountain Lake and westward antelope have been seen although they are said to be getting scarce in the Sask. Landing country where they were formerly abundant. Problems with new settlers not familiar with game laws - violations of Ordinance. Game Guardian recommendations for change in "Ordinance" (Act): - Three recommended antelope season open Nov. 1 to Jan. 1. - Four recommended antelope season open Nov. 15 to Dec. 1. - One recommended opening antelope season Sept. 15 (no closing date mentioned).
1906	Guest permits ($1.00): guests of residents allowed to shoot with their hosts for five days as allowed by law. Three (3) general shooting licences issued to non-residents.
1907	Antelope are found throughout the prairie but are becoming more scarce as settlement extends. Many of these animals died during the winter of 1906-07 owing to the quantity of snow preventing their feeding freely, and in the weakened and starved condition many of them succumbed to the wolves. It is reported also that many drifted against the wire fences along the railroad and there died while endeavouring to make their way southward. Reports from points throughout the settled portions of the province: Goose Lake - Close season for antelope and deer for four years. Crane Lake - Antelope suffered severely from starvation and cold and many killed by coyotes. Prohibition of spring shooting. Provision was made for the shooting of female antelope because of the frequent difficulty of discriminating between sexes - **See Buck Law**; comments 1914.
1908	Ninety (90) guest permits ($1.00) issued as opposed to nine $50.00 licences sold to non-residents. Proposed that residents should have to purchase a licence for big game except on their own property. The unusually severe winter of two years ago with the great depth of snow at that time caused the destruction through starvation of thousands of antelope, and since that time they have not been plentiful.

Year	Commentary
	In small groups of two or three southwest of Moose Jaw; north of the CPR line between Morse and Maple Creek they were more plentiful, being in bunches of 20 and 30 at a time. Antelope disappeared from southeastern part of province (Estevan) - few small herds in Balgonie area and further east: - Antelope reported scarce in Yorkton area but a couple of herds were noted. - Antelope observed in small bunches in the Pleasantdale Hills area and probably total 200 animals. - Few bunches of antelope observed south of Vonda and Dana. - Antelope seen at three points east of Prince Albert. - C.N.R. line north to Prince Albert: "Antelope are becoming scarce in the open prairie region but a few bunches are said to be still running in the park country north of the Saskatchewan river." - C.N.R. west of Warman: "Small bunches of antelope were seen at eight different places mostly south of the line to the number of probably 150." - C.P.R. westward from Regina: "Although antelope are nothing like as abundant as a few years ago, being counted in tens where they were hundreds, information is at hand of 35 or more bunches, numbering in all probably 1,000 head, scattered over that part of the province west of the Soo line between the United States boundary and the south branch of the Saskatchewan River."
1909	Resident Big Game licence = $2.00; Non-resident = $50.00. **No Bag Limit** - i.e. could purchase more than one big game licence.
1910	One man convicted of shooting antelope out of season - $20.00 fine. Report of Neil Gilmour, Southwest District Game Guardian: - Antelope becoming scarce because of increased settlement - must in short time become extinct.
1911	Total of 765 big game licences sold - what proportion used for antelope unknown.
1912	Four men convicted of "Shooting antelope out of season" - each fined $10.00. **No Bag Limit** - i.e. could purchase more than one big game licence. Report of Neil Gilmour, Southwest District Game Guardian: "As the settlement of even the roughest parts of the province extends year by year, the antelope are becoming less and less numerous, and I think it is doubtful if even the making of a close season the year round would save them from extinction." "I am of opinion that the only hope for their preservation would be an inclosed reserve with a guardian in charge." Report of F. J. Fitzpatrick, Southeast District Game Guardian: "...closing the antelope season the same as beaver, as these animals are almost extinct in the southern part of the province." Sold 1,755 big game licences in 1912 - what proportion used for antelope unknown. Of 220 Voluntary Game Guardians, only three reported seeing antelope in the southwestern and one in central-western portions of province.
1913	Report of Voluntary Game Guardians: Central-Southern - Few straggling antelope are reported as having been seen in the west part of this district. - Few hunters because antelope were not in sufficient numbers to induce the hunters to take up the chase. - Antelope reported to be in danger of extermination. South-Western - Big game have almost left this district - there are very few antelope. - One guardian reports: "The provisions of The Game Act are observed somewhat indifferently by farmers in outlying districts, especially in the case of antelope shooting." - "This is a pity, as they need every protection if they are to survive." Central - One correspondent, who resides in the former range of the antelope, says: - "I have not seen any antelope for five years, nor heard of them. I am afraid they are gone." - Antelope reported to be in danger of extermination Central-Western - A Kelfield guardian reports antelope to be increasing slowly, and from Alsask, this animal is said to have been fairly plentiful. - However, high numbers of hunters in 1913 caused a decline and on the whole, antelope are considered to be in danger of extermination in this district.

Year	Commentary

North-Western
- Four years ago in the Rabbit Lake area antelope were very plentiful, now they are very scarce.

Total of 1,644 big game licences issued with 1,212 licensees having made their returns as required by law.

"Every person to whom a big game licence is issued is required by law to return such licence immediately after the close of the open season, accompanied by an affidavit showing the number and kind of animal killed."

Reported harvests: Moose = 470, Deer = 328, Elk = 60, Caribou = 5, Antelope = 15, Unsuccessful = 562.

Est. antelope kill if all hunters had reported = 20.

Season: Nov. 15 to 30 **First year where hunters compelled to wear a white suit.**

First part of winter mild and no snow until mid January.

At the end of the 1913 session of the Legislature, antelope and whooping cranes were added to the list of game which is completely protected for an indefinite time.

Buck Law has been in force for some time before 1913.

Summary of Chief Game Guardian: "In our province today, the antelope is on the verge of extermination, and the whooping crane is now rarely seen. Both these species now receive complete protection by law, but everything is so much against their chances for increase that it is doubtful whether or not they will survive the devastation that has already been wrought. Just imagine if you can the days when the antelope roamed our prairies by the million, then compare those conditions with the state of affairs today."

"It is estimated that no more than 1,500 of these graceful animals are now to be found in Saskatchewan and they are decreasing year by year due to the encroachment of settlers upon their former breeding grounds, who have been killing them for years without any attempt to preserve them. Every province and state that possesses antelope, except Nevada, has passed laws protecting this species for long periods."

1914

Report of Neil Gilmour, Southwest District Game Guardian:
- "Rapid settlement even in roughest parts has caused the rapid depletion of the herds that only a few years ago were so numerous."
- Gilmour was convinced the only way to save the antelope from total extinction was to set up antelope reserves.
- In two years time it may be too late - antelope found only in small bunches not more than a dozen in a herd.
- Gilmour the only guardian now reporting antelope in his district.

Buck Law being pressured by hunters who want to shoot females as well as bucks.

Mr. Maxwell Graham, Chief of the Animal Division of the Dominion Parks Branch, together with Mr. Ernest Thompson Seton, the world-famed naturalist, made an investigation with a view to setting aside certain reserves for the antelope in Saskatchewan.
- Only reserve set up was at Foremost, Alberta (42 animals enclosed by fence) although Graham & Seton identified nine sections near Moose Jaw and 20 sections near Maple Creek.

Total of 1,725 big game licences sold - **No Antelope Season.**

1915

Six men convicted of shooting antelope - total fines $280.00.

Report of Neil Gilmour, Southwest District Game Guardian:
- "Antelope once so numerous, now fast disappearing."
- Very dry spring; little snow the winters of 1913 to 1915, inclusive.
- Although protected, poaching a problem in further reducing antelope numbers.

Total of 2,136 big game licences sold - **No Antelope Season.**

1916

Numbers of hunters much below normal as many are involved with W.W.I.

Three men convicted of shooting antelope - $20.00 each.

No Antelope Season

Report of Neil Gilmour, Southwest District Game Guardian:
- Closed season for the past two years may not be enough to save them from extinction.
- Only two or three little bunches left in entire province.
- Poaching a continual problem.

1917

No Antelope Season

One man convicted of hunting antelope ($150.00) and another of shooting an antelope ($200.00).

Supply of antelope continues to diminish - few observations.

Report of Neil Gilmour, Southwest District Game Guardian:
- Knows of only two bunches during 1917, one group of 25 to 30 animals south of Secretan.

Year	Commentary
1918	**No Antelope Season** "Spanish" influenza epidemic prevented hundreds of sportsmen from taking part in big game hunting. Scattered herds of antelope here and there in southwest portion of province west of Moose Jaw. - Still threatened with extinction.
1919	**No Antelope Season** Legislation: Person accidentally killing a female big game animal, other than a fawn is required to dress, care for and return to game guardian. No mention of antelope in Annual Report. 1918 & 1919 were drought years.
1920	**No Antelope Season** Report of Neil Gilmour, Southwest District Game Guardian: - Southern portion of province: "It is said that in one or two localities a few antelope are still to be found." - "Inevitable destruction."
1921	**No Antelope Season** Plentiful in S.W. Sask 20 to 30 years ago - today estimate only 200 to 250 animals after Dept. census. Remaining populations located on private or leased ranches. Mr. Thompson Seton estimated that about the time of the first settlers came to the west, there were no less than 20,000,000 animals.
1922	**No Antelope Season** Little or no change in antelope situation from 1921. Two confirmed reports of 12 antelope north of P.A. and eight northwest of Little Trout Lake on small open grasslands surrounded by forest !!! Report of Neil Gilmour, Southwest District Game Guardian: - Now reports antelope in about six small scattered herds. - Has reported very poor big game populations in southern Sask. for a number of years now - maybe be general trend for all big game, not just antelope.
1923	**No Antelope Season** Writing of the antelope in 1912, Dr. Hornaday says, "The prong-horned antelope, unique and wonderful, will be one of the first species of North American big game to become totally extinct. We may see this come to pass within twenty years." Maximum Provincial population estimate not more than 200, or at the most 250, where half a century ago there were perhaps 200,000 of these little denizens of the plains.
1924	**No Antelope Season** Report of Neil Gilmour, Southwest District Game Guardian: - Reports no change regarding antelope population increase.
1925	**No Antelope Season** One man convicted of shooting an antelope - fined $50.00. Report of Neil Gilmour, Southwest District Game Guardian: - Winter of 1924-25 was one of considerable snow - spring of 1925 was not early, cold weather continuing through March and the first days of April. - Encouraging reports of increases in antelope numbers particularly in the Great Sandhills region. - First report in a number of years of antelope (one herd of 25) in extreme southwest (Govenlock area).
1926	**No Antelope Season** Report of Neil Gilmour, Southwest District Game Guardian: - Severe temperatures and snow the last week of March through to mid April. - More encouraging reports of antelope increasing - suspects population double from what was reported two years ago. - Estimated population = 400 to 500. - Local people becoming protective of "their" small herds.
1932	**No Antelope Season - 1928, 1929, 1930, 1931 & 1932** Deer plentiful throughout province - indicator for antelope ?? Two antelope taken illegally.
1933	**No Antelope Season** Game Commissioner stressed the need for a biological survey of big game.

Year	Commentary
1934	**No Antelope Season**
1935	**No Antelope Season** Sask. has suffered depletion of its wildlife resource the past few years - restoration and conservation presents a problem which must be faced and solved. Early winter with deep and crusted snow conditions followed by extreme and continued low temperatures. A considerable increase in the number of deer and antelope reported despite winter conditions.
1936	Serious draught prevalent the past few years (includes 1936). Antelope populations have done so well with the No Hunting Seasons that a short, open season was declared - 267 animals harvested; Hunter success unknown. No adverse effects on population size noted in spring of 1937 so season will continue. Antelope observed in new areas.
1937	The Prong-Horned Antelope, threatened with extinction a few years ago, has increased throughout the south western section of Saskatchewan to the extent that a short open season has been found possible." Antelope harvest fell by 103 animals despite an increase in total big game licence sale of 1,084 in 1936 to 1,174 in 1937.
1938	Antelope continuing to increase and are spreading to their former breeding grounds - new herds along Sask. River and Dirt Hills as well as open country in the south from Alberta border as far east as Ceylon. Farmers and ranchers interested in this species and are assisting in conservation.
1939	Little snow - good winter. Antelope population increasing in certain areas of the extreme southwest. Depredation - "The open season of the previous year (1938) was considered by close observers to have had the desired effect of breaking up the very large herds which were becoming a menace to the grass areas of certain ranchers." **No Open Season for Antelope** - it was thought that a season would seriously dep e existing populations.
1940	Antelope showed a marked increase in SW - **Open** season declared - bag of one animal of either-sex. Not uncommon to see herds of 300 to 400 south of the Cypress Hills - range still confined to a smaller area than formerly. - Still spreading, though, into areas where antelope have not been reported for 15 or 20 years, or even longer periods. Recovery attributed to the protection of ranchers and farmers who had remnant herds in years past. Antelope licences now sold separately from the general big game licence.
1941	Antelope have shown satisfactory increas - noticeable now around Wood Mtn., Big Muddy, Chaplin, Lake Johnson and Webb Sandhills.
1942	Antelope continue to increase and spread: - Largest increases reported in Great Sandhills area and along South Sask. River from Alberta east to Outlook. - New herds seen in the Val Marie, Killdeer, Coronach and Buffalo Gap districts.
1943	Heavy snowfall in spring resulted in decreases in big game. Winter exceptionally open with very little, if any, snowfall. Steady and increasing population.
1944	Amateur antelope hunters met with mostly disappointment as very few animals were taken, i.e. very poor hunter success.
1945	Population rapidly increasing. Populations around Cypress Hills and Govenlock are increasing. Populations north of South Sask. River not as productive and season may have to be closed.
1946	Severe winter of 1946-47. Number of antelope taken in season was not appreciable. Herd rapidly increasing up to winter.
1947	**No Open Season** in Saskatchewan and Alberta. Extreme southwest population did not return from U.S.A. due to high water levels & abnormal spring conditions.

Year	Commentary
1948	Populations north of South Sask River not in sufficient numbers to warrant a season.
1949	For the first time in Saskatchewan, an aerial antelope survey was conducted. May survey of antelope jointly shared by Montana, Alberta and Saskatchewan. Long, severe winter with deep snow - many antelope in starving condition - favourable result in McCord area. Herd of 1500 moved into Sask. from Brooks, Alta.
1950	**No Open Season** Aerial survey revealed a 30 to 40 per cent decline due to severe winter conditions in 1950-51. Very few kids seen in survey. Main concentration of animals located in extreme southwest.
1951	**No Open Season** Aerial survey indicated insufficient antelope for season.
1952	**Bucks Only Season** in southwestern section of the province. Aerial surveys indicated a preponderance of bucks. Either-sex season usually results in 40 per cent being does - Bucks only resulted in only 5 per cent being does. Aerial survey results showed that a new survey method was required. An extensive bag check was made of antelope hunters during the hunting season.
1953	**Bucks Only Season** in southwest section of province. Hunter success dropped from 80 per cent in 1952 to 60 per cent in 1953. It is unfortunate that the season cannot be opened until after stock is taken out of the Community Pastures at the end of October, as some of the best antelope range lies therein. Some bucks have dropped their horn shells by that time, making it more difficult to identify their sex at a distance. Popular report produced to public. Intensive aerial survey conducted.
1954	Aerial and ground surveys revealed a higher female to male ratio than in previous years and a number of late fawns due to large harems with only one buck - can't service all does first eosterus, thus late fawns. In some areas the buck to doe ratio was 1:8 or 1:10, whereas the ratio in other areas was 1:1. The reason for this situation appears to be that the antelope range is broken up by farmland, restricting the easy flow of populations which would permit more or less uniform harem acquisition. In order to utilize community pastures for antelope hunting, it was necessary to set the season later than desirable. One week either-sex season - all hunters required to visit a check station. Average hunter success was 71 per cent as compared to 57 per cent in 1953 (bucks only). Able to hunt in seven southwestern zones.
1955	Aerial and ground surveys. Either-sex season Nov. 7 to 12 in Zones 6 and 8 to 14. Heavy snowfall and very cold weather reduced the number of hunters and kill. Mandatory check station results: 2,857 hunters reported taking 1,886 antelope, a 66 per cent success rate. Winter severity not severe - losses not serious.
1956	Surveys showed population relatively unchanged. Zones north of South Sask River very small and growing very slowly. Range extensions noted in Zones 4, 5 and 7 - none have been open for antelope seasons for a number of years. Check stations operated again in 1956. Nov. 5 to 10 either-sex season had a success rate of 71 per cent. Exceptionally mild winter.
1957	July aerial survey indicated population unchanged from previous year. 15 check stations operated - co-op study with Montana on sex, age and weights - **Harvest Results:** 34 per cent fawns, 21 per cent yearlings, 13 per cent 2½ year olds and 32 per cent 3½ or greater; n = 557 animals. Hunter success 72 per cent - Zone 12 accounted for a large proportion of harvest. Seasons: Either-sex Nov. 4 to 9 in Zones 6, 8 to 12 and 13 (that portion south of the South Sask. River).

Year	Commentary
1958	Aerial surveys reduced to one transect every four miles - totalled 2,322 miles - 1,672 antelopes observed, almost identical to 1957 count of 0.72 mi². - Govenlock area highest densities at 1.4 antelopes/mi². Compulsory check stations disbanded - only three operated - checked 569 hunters on Nov. 3 and 4. - Reported 61 per cent success rate the first two days; questionnaire results calculated final success at 82 per cent. - **Harvest Ratio:** almost 1 male : 1 female; 27 per cent fawns, 25 per cent yearlings, 15 per cent 2½ year olds, and 33 per cent 3½ and older. Seasons: Either-sex Nov. 3 to 8 in Zones 6, 8 to 12 and 13 south of River.
1959	Voluntary check stations in operation. Season: Either-sex Nov. 2 to 7 - Hunter success only 64 per cent - partially due to poor weather. Harvest by day and per cent of total: Nov. 2 - 1,605 63.0 per cent; Nov. 3 - 291 11.4 per cent; Nov. 4 - 127 5.0 per cent; Nov. 5 - 112 4.4 per cent; Nov. 6 - 135 5.3 per cent; Nov. 7 - 278 10.9 per cent.
1960	Voluntary check stations in operation. Season: Either-sex Oct. 31 to Nov. 5 - Hunter success 74 per cent. Harvest by day and per cent of total: Oct. 31 - 2,164 67.6 per cent; Nov. 1 - 417 13.0 per cent; Nov. 2 - 214 6.7 per cent; Nov. 3 - 87 2.7 per cent; Nov. 4 - 145 4.5 per cent; Nov. 5 - 175 5.5 per cent.
1961	Voluntary check stations in operation. Season: Either-sex Oct. 30 to Nov. 4 - Hunter success 69 per cent. **First Year Licences Allocated by Draw** A draw was held and as a result 3,700 applicants became eligible to purchase an antelope licence. However, only about 2,900 applicants did purchase licences, thus the number of licensees was reduced from the previous year by approximately 1,400. Harvest by day and per cent of total: Oct. 30 - 1,167 64.8 per cent; Oct. 31 - 385 21.4 per cent; Nov. 1 - 81 4.5 per cent; Nov. 2 - 45 2.5 per cent; Nov. 3 - 51 2.8 per cent; Nov. 1 - 72 4.0 per cent. During the last four years, the onslaught of early winter storms have made antelope hunting difficult in some areas, virtually impossible in others.
1962	Present day design of survey blocks started in 1960 and consisted of five permanent census blocks. **Season: Either-sex Oct. 22 to Oct. 27 **(Season Dates Advanced One Week Earlier)**** - Hunter success 87 per cent (highest on record). Harvest by day and per cent of total: Oct. 22 - 1,580 69.4 per cent; Oct. 23 - 401 17.6 per cent; Oct. 24 - 102 4.5 per cent; Oct. 25 - 61 2.7 per cent; Oct. 26 - 34 1.5 per cent; Oct. 27 - 98 4.3 per cent. Antelope hunters reported travelling (one-way, in miles from home) an average of 205 miles.
1963	Change in survey numbers **significantly greater** than 1962. Season: Either-sex Oct. 21 to Oct. 26 in Zones 7 to 12 and 16 - Hunter success 85.7 per cent. Harvest by day and per cent of total: Oct. 21 - 1,973 68.5 per cent; Oct. 22 - 498 17.3 per cent; Oct. 23 - 164 5.7 per cent; Oct. 24 - 69 2.4 per cent; Oct. 25 - 55 1.9 per cent; Oct. 26 - 121 4.2 per cent. Antelope hunters reported travelling (one-way, in miles from home) an average of 211 miles.
1964	Ratio of kids in population declined - reason unknown. Season: Either-sex Oct. 26 to Oct. 31 - Hunter success 88 per cent. Harvest by day and per cent of total: Oct. 26 - 1,578 68.9 per cent; Oct. 27 - 343 14.9 per cent; Oct. 28 - 114 4.9 per cent; Oct. 29 - 69 3.0 per cent; Oct. 30 - 46 2.0 per cent; Oct. 31 - 137 5.9 per cent. Antelope hunters reported travelling (one-way, in miles from home) an average of 229 miles.
1965	Winter of 1964-65 severe - high mortality and movement out of province - kid crop very light. Change toward more does relative to bucks - lowest buck to doe ratio recorded over the last five years. **Season: Closed !!!**

Year	Commentary
1966	75 per cent increase in population as compared to 1965 - density of 0.88/mi² - highest proportion of does to bucks on record. Believed that population increase partially due to an influx of animals from Montana and Alberta. **Recommendation:** Allow hunting in 1966. Season: Either-sex Oct. 31 to Nov. 5 - Hunter success 82 per cent. Harvest by day and per cent of total: Oct. 31 - 1,429 69.7 per cent; Nov. 1 - 328 16.0 per cent; Nov. 2 - 115 5.6 per cent; Nov. 3 - 62 3.0 per cent; Nov. 4 - 45 2.2 per cent; Nov. 5 - 71 3.5 per cent. Change in Draw procedure due to hunter dissatisfaction in method of issuing licences.
1967	27 per cent decrease in population - higher proportion of bucks to does than in 1966 - good fawn to doe ratio. **Recommendation:** Reduce licence quotas. Voluntary check station in operation the first two days of season. Season: Either-sex Oct. 30 to Nov. 4 - Hunter success 83 per cent. Harvest by day and per cent of total: Oct. 30 - 683 68.6 per cent; Oct. 31 - 116 11.7 per cent; Nov. 1 - 58 5.8 per cent; Nov. 2 - 38 3.8 per cent; Nov. 3 - 41 4.1 per cent; Nov. 4 - 60 6.0 per cent.
1968	27 per cent increase in population - slightly below long term average since 1961. Was felt antelope population **underharvested** in 1967. Voluntary check station in operation - **Repro Tracts Collected.** Season: Either-sex Oct. 28 to Nov. 2 - Hunter success 88.4 per cent. Harvest by day and per cent of total: Oct. 28 - 1,785 67.3 per cent; Oct. 29 - 321 12.1 per cent; Oct. 30 - 111 4.2 per cent; Oct. 31 - 74 2.8 per cent; Nov. 1 - 162 6.1 per cent; Nov. 2 - 199 7.5 per cent.
1969	5.6 per cent increase in population - **Not Significant** - density 0.87/mi² - SW Sask. average since 1961 = 0.82/mi². Antelope population appears to be levelling off to equilibrium. Although antelope numbers are now fairly constant province-wide, there appears to have been a shift in densities to the more northern part of the range. Status Quo for licences issued in 1969. Voluntary check station in operation - **Repro Tracts Collected.** Season: Either-sex Oct. 27 to Nov. 1 - Hunter success 88.3 per cent. Harvest by day and per cent of total: Oct. 27 - 1,321 61.7 per cent; Oct. 28 - 313 14.6 per cent; Oct. 29 - 165 7.7 per cent; Oct. 30 - 105 4.9 per cent; Oct. 31 - 85 4.0 per cent; Nov. 1 - 152 7.1 per cent.
1970	6.7 per cent increase in population - **Not Significant** - appears to have stabilized. The ratio of 0.77 kids:1 doe is only slightly below the 10 year average of 0.79:1. Population mean above the 10 year average of 3,992. As indicated in previous reports, a July survey of the Matador area is inadequate. Ecologist Hnatuik estimates the winter population to range between 200 and 300 antelope. It is hoped that current autumn harvests are successful enough to regulate antelope numbers within the winter range carrying capacities of Sask. and Montana. Voluntary check station in operation - **Repro Tracts Collected** - **Note:** Oldest animals in western part of province, younger animals in east - may be indication of younger animals emigrating to new range and/or growing population. Season: Either-sex Nov. 2 to 7 - Hunter success 86.6 per cent. Season extended in Zones 3 & 6 for **one day.** Harvest by day and per cent of total: (fog first two days of season) Nov. 2 - 2,161 62.4 per cent; Nov. 3 - 426 12.3 per cent; Nov. 4 - 215 6.2 per cent; Nov. 5 - 177 5.1 per cent; Nov. 6 - 152 4.4 per cent; Nov. 7 - 333 9.6 per cent.
1971	13.9 per cent decrease in pop. - **No Significance Level Placed on Change** - largest decrease in no. of bucks observed - probably result of hunter selection in 1970. Over the past two years more information was gathered through the research program being carried out which emphasized the need for greater harvest due to heavy utilization of their winter range and resulting winter mortality. Even the large quota of 4,000 licences last season failed to offset this problem. Based on data gained through the research project, it is therefore recommended that the number of antelope permits be available to hunters be set at a number similar to the 1970 quota though **The Population has Dropped Slightly.** Voluntary check station in operation - age structures indicate young, growing population. Season: Either-sex Oct. 25 to 30 (****Note Starting Date****) - Hunter success 84.9 per cent. Harvest by day and per cent of total: Oct. 25 - 1,966 63.5 per cent; Oct. 26 - 443 14.3 per cent; Oct. 27 - 142 4.6 per cent; Oct. 28 - 115 3.7 per cent; Oct. 29 - 139 4.5 per cent; Oct. 30 - 291 9.4 per cent.

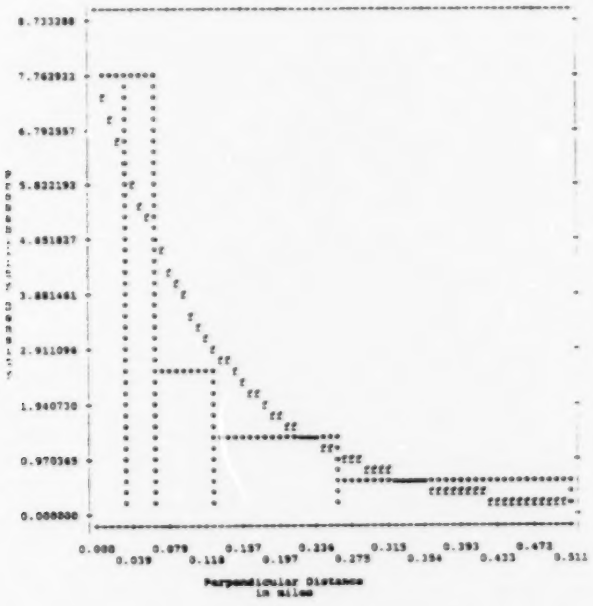
Year	Commentary
1972	Season: Either-sex Oct. 30 to Nov. 4 - Hunter success 83.3 per cent.
1973	Hunter success 79.9 per cent.
1974	**Season Closed in 1974**
1975	Season: Either-sex Oct. 27 to Nov. 1 - Hunter success 81.9 per cent.
1976	6 per cent of these licences were issued for an antelope archery season - Sept. 6 to Oct. 16. Season: Either-sex Oct. 25 to 30 (**Note Opening Date**) - Hunter success 76.2 per cent. 11.5 per cent increase in 1976 aerial surveys compared to 1975 levels.
1977	6 per cent of licences for archery - Sept. 19 to Oct. 15. Voluntary check station in operation. Season: Either-sex Oct. 31 to Nov. 5 - hunter success 79.9 per cent. 13.1 per cent decrease in 1977 aerial surveys as compared to 1976 level. Page 84 in 1977 Report of Hunter and Game Population Surveys calculated a 25.9 per cent reporting error on hunter questionnaire.
1978	6 per cent of licences for archery - Sept. 11 to Oct. 14. Voluntary check station in operation. Season: Either-sex Oct. 30 to Nov. 4 - Hunter success 79.5 per cent. 5.4 per cent decrease in 1978 aerial surveys as compared to 1977 level. Low antelope counts in Zone 3 - very severe winter conditions in Montana and SE Alberta. - Severe winter conditions in Dec. & Jan. on Sask. winter range but mild temperatures and low snowfall in latter stages of winter. Page 106 in 1978 Report of Hunter and Game Population Surveys compares reporting errors in hunter questionnaire. - Reporting error for mule deer = 6.3 per cent while antelope = 16.7 per cent: Results indicate continued high reporting error for antelopes !!!
1979	Hunter success 84.7 per cent. 8.4 per cent decrease in 1979 aerial surveys as compared to 1978 level.
1980	6 per cent of licences for archery - Sept. 8 to Oct. 11. Season: Either-sex Oct. 27 to Nov. 1 - Hunter success 71.2 per cent. 11.2 per cent increase in 1980 aerial surveys as compared to 1979 level.
1981	150 archery licences issued with bowhunter success being 18.8 per cent (28 animals) - 1980 success 13 per cent. Voluntary check station in operation the first two days of season. Season: Oct. 26 to Oct. 31 - Hunter success 74.0 per cent. 1981 survey noted build-ups in peripheral antelope range.
1982	1982 survey revealed increase of 24.5 per cent in provincial population from 6,491 to 8,555. Estimated provincial population (**Native Range** only): 1980 = 6,183; 1981 = 6,789; 1982 = 8,555. Eastern edge of range (GMZ 7, E½ of 8, 9 & 12) hard hit with deep snow and cold temperatures during 1981-82 winter. Low Kid:Doe ratio attributed to late May snowstorm that hit spring of 1982. High survival of 1981 kids as indicated by high number of yearling bucks. **Mgm't Objective:** Stabilize provincial population at 9,000 antelope. Season: Either-sex Oct. 28 to Nov. 3 - Hunter success 76.6 per cent. Believed immigration of 1,500 antelope from Montana and Alberta.
1983	1.5 per cent decline in 1983 surveys compared to 1982 - Estimated population = 8,339 (WMZ 12 omitted). Winter of 1982-83 extremely mild. 1983 survey indicated a stable population of 8,000 plus with kid to doe ratio (0.85:1) well above 1982 & average. Season: Either-sex Oct. 27 to Nov. 2 - Hunter success 78 per cent.
1984	17.8 per cent increase in 1984 surveys compared to same WMZ from 1983 - Estimated population = 10,821 (includes 1,000 from "peripheral zones"). A proportionally high number of non-breeding yearlings, stemming from near-record high production in 1983 and excellent winter survival, contributed to lower reproductive ratios. The spring and summer drought experienced over much of the primary antelope range may also have depressed reproductive output to a degree. **Mgm't Objective:** Introduction of limited quotas in WMZs 4, 24 & 25 while increasing harvest in WMZs 3, 7 and 9. Season: Either-sex Oct. 29 to Nov. 3 - Hunter success 76.6 per cent.

Year	Commentary
1985	2 per cent increase in 1985 surveys compared to 1984 - slightly more coverage (7,534 km² or 2,920 mi²) because of realignment of blocks to correspond to new WMZs. Good reproduction in light of draught conditions in 1984 & 1985. Early blizzard at end of October 1984 resulted in movement of antelope into Montana where range conditions were fair. - Contributed to good survival and spring reproduction. Fall rains and ample snowcover in 1984 and spring rains may have accounted for good reproductive success north of the Trans Canada Highway (ie. negate effects of drought - improved range). **Mgm't Objective:** Increase licence quotas by 9 per cent and introduce season in WMZ 19. Season: Either-sex Oct. 28 to Nov. 2 - Hunter success 57.7 per cent - very poor relative to antelope population.
1986	Surveys reduced 52 per cent in size from 7,534 km² to 3,691 km² - WMZ 2, 3 & 9, only. 14 per cent increase in 1986 surveys compared to 1985 - WMZ 2, 3 & 9 only. Estimated population exceeds 12,000 animals. Winter of 1985-86 moderate with ideal spring fawning conditions in 1986. **Mgm't Objectives:** Only increase lic. quota by 25 lic. - response to depredation concerns in WMZ 10 (100 in 1985; 125 in 1986). - WMZ 23 added in combination with WMZ 19. Season: Either-sex Oct. 29 to Nov. 5 - Hunter success 80.4 per cent.
1987	The 1987 survey abbreviated to sex and age composition estimates only - **No Densities.** Winter of 1986-87 mild and 1987 spring ideal - good to excellent range conditions. Indications are that provincial population continues to increase. Widespread landowner concern about depredation on field crops. **Mgm't Objectives:** Increase lic. quota by 17 per cent (500 lic.) - hunter demand still exceeds supply of antelopes. Season: Either-sex *** Oct. 29 to Nov. 14 *** estimated to accommodate hunters who also have a mule deer lic. - Hunter success 83.7 per cent. - 75 per cent of the 1986 antelope hunters also had a mule deer lic. - A high percentage of bucks shed one or both horns by the start of the season. - 70 per cent of hunters participated first three days, 20 per cent second week and 10 per cent third week.
1988	Survey consisted of both density and sex/age estimates in WMZ 2, 3 & 9. High proportion of yearling females and poor fawn survival as a result of spring draught conditions contributed to lower Kid:Doe ratios. - Kid to Mature Doe dropped to 0.82 indicating loss due to draught. Provincial population is still growing steadily despite lower kid:doe ratios - series of mild winters and good to excellent kid survival. Widespread landowner concern about depredation on field crops as a result of high population and loss of native range - **Competition with Cattle in Dry Years.** - Antelope attracted to agricultural crops during fall, winter and spring. **Mgm't Objectives:** Increase lic. quota by 31 per cent (1,075 lic.). Season: Either-sex Oct. 27 to Nov. 19 (except WMZ 3 - Oct. 29) - Hunter success 82.3 per cent.
1989	Provincial population is still growing despite lower kid:doe ratios - series of mild winters and good to excellent kid survival. - 14.3 per cent increase in density from 1988 - reproductive rates remained below long-term average. - Two additional blocks flown including coverage of farmland areas in WMZ 8 & 10. Widespread landowner concern about depredation of field crops as a result of high populations and loss of native range - **Competition with Cattle in Dry Years.** - Antelope attracted to agricultural crops during fall, winter and spring. **Mgm't Objectives:** Increase lic. quota by 13 per cent (600 lic.). - Experimental Muzzleloading season in WMZ 7 and 14. Season: Either-sex Oct. 26 to Nov. 18 (except in WMZ 3 - Oct. 30) - Hunter success 82.5 per cent. Supply close to demand as not all licences sold.
1990	More extensive survey program was flown in early June over much of the provincial antelope range. Surveys incorporated technique called Line Transect. - Estimate provincial adult population approximately 24,700. Herd structure ratios of 53 bucks:100 does:61 kids similar to 1989. Growing landowner demands for lower antelope numbers. Interest in muzzleloading season (WMZ 7 and 14, only) high - 177 hunters participated. **Mgm't Objectives:** Increase lic. quota by 29 per cent (1450 lic). - Expand muzzleloading portion of firearm season to all WMZs, exceed WMZ 3. - Open WMZ 27 and amalgamate with combined WMZ 14, 24, 25 and 26. - Archery draw quota increased to accommodate all applicants (450 lic.).

APPENDIX II. Estimated densities (mi^2) as calculated by five models and estimated probability density function of perpendicular distance (f) fit to histogram of data (*) for the best fit model for each survey block (White, 1988).

Survey Block 1A: **Negative Exponential Series**[a]

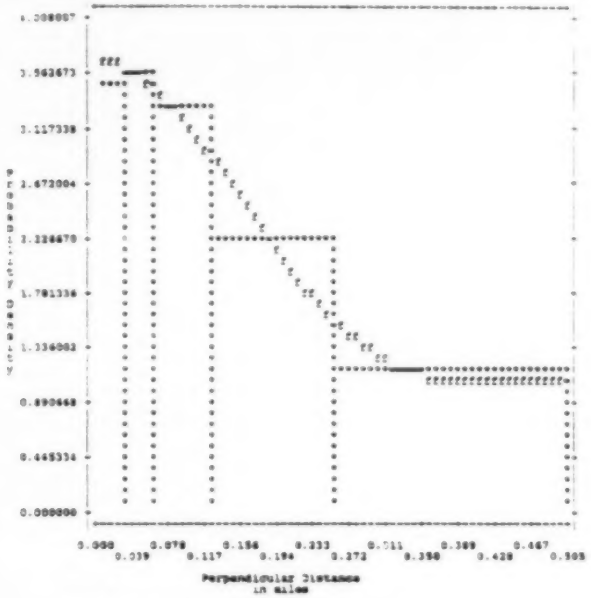
Estimator Name	No. Par.	Density Estimate	Standard Error	% Coef. Var.	95 Percent Confidence Interval	
Fourier Series	2	0.1806	0.6496E-01	35.96	0.3766E-01	.3236
Exponential Power Series	2	0.2611	0.2656	101.75	-.3236	.8458
Exponential Polynomial	2	0.2252	0.2475E+07	******	-.5447E+07	.5447E+07
Negative Exponential	1	0.2252	0.9739E-01	43.24	0.1087E-01	.4396
Half-normal	1	0.1403	0.5043E-01	35.95	0.2927E-01	.2513



[a]Survey block(s) and best fit model.

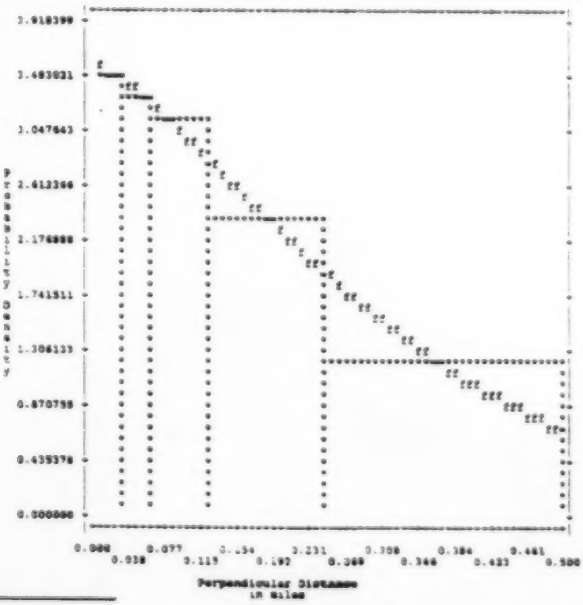
Survey Blocks 2A, 2B and 2C: Fourier Series Estimator (parameters = 2)[a]

Estimator Name	No. Par.	Density Estimate	Standard Error	% Coef. Var.	95 Percent Confidence Interval	
Fourier Series	2	1.359	0.1633	12.01	1.022	1.696
Exponential Power Series	2	1.404	0.2419	17.24	0.9044	1.903
Exponential Polynomial	2	1.441	0.2377	16.50	0.9503	1.931
Negative Exponential	1	1.536	0.1806	11.76	1.163	1.909
Half-normal	1	1.230	0.1256	10.21	0.9710	1.489



Survey Block 3A: Exponential Power Series Estimator[a]

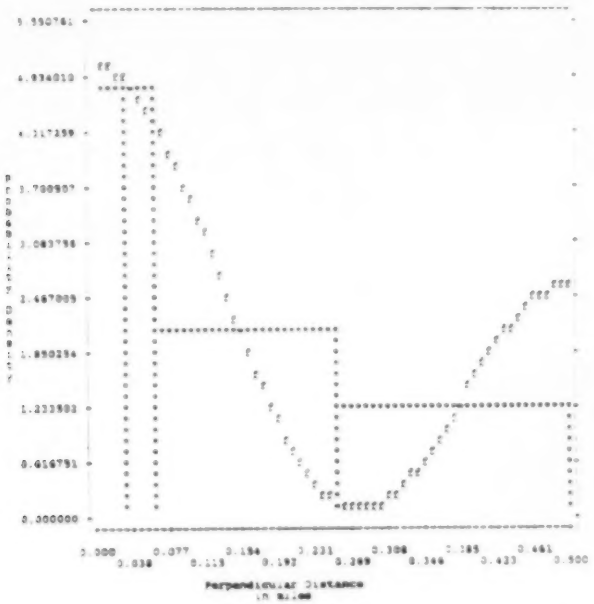
Estimator Name	No. Par.	Density Estimate	Standard Error	% Coef. Var.	95 Percent Confidence Interval	
Fourier Series	2	1.644	0.2079	12.65	1.210	2.077
Exponential Power Series	2	1.696	0.2757	16.26	1.120	2.271
Exponential Polynomial	2	1.730	0.2882	16.66	1.129	2.331
Negative Exponential	1	1.903	0.2319	12.18	1.420	2.387
Half-normal	1	1.549	0.1674	10.81	1.199	1.898



[a]Survey block(s) and best fit model.

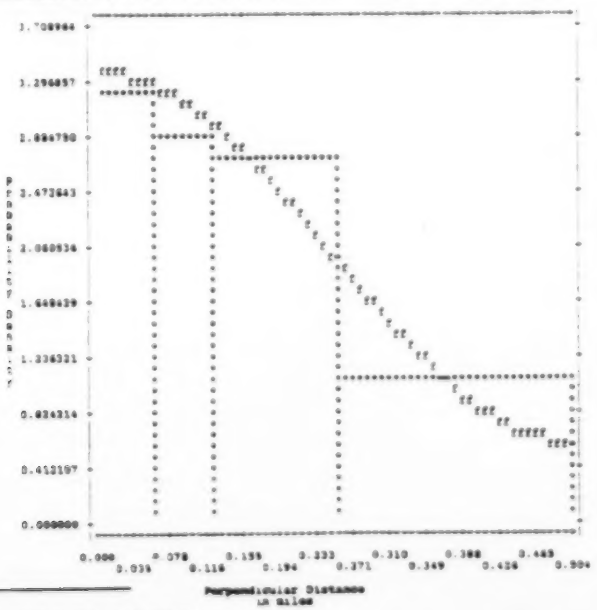
Survey Block 4: Fourier Series Estimator (parameters = 2)[a]

Estimator Name	No. Par.	Density Estimate	Standard Error	% Coef. Var.	95 Percent Confidence Interval	
Fourier Series	2	0.3565	0.1172	32.87	0.1012	.6119
Exponential Power Series	2	0.2779	0.2974	78.69	-.2701	1.026
Exponential Polynomial	2	0.3185	0.1184	37.18	0.6045E-01	.5765
Negative Exponential	1	0.3185	0.9739E-01	30.58	0.1062	.5307
Half-normal	1	0.2381	0.5866E-01	24.63	0.1103	.3659



Survey Block 5: Fourier Series Estimator (parameters = 1)[a]

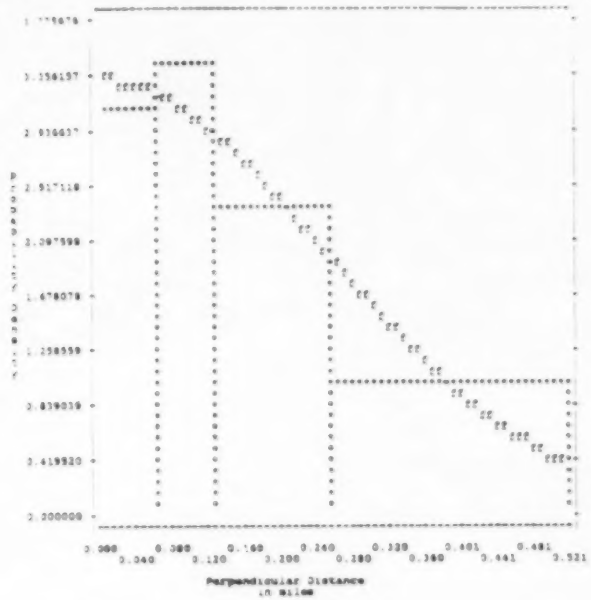
Estimator Name	No. Par.	Density Estimate	Standard Error	% Coef. Var.	95 Percent Confidence Interval	
Fourier Series	1	0.3964	0.1088	27.44	0.1594	.6335
Exponential Power Series	2	0.3597	0.1159	32.22	0.1072	.6122
Exponential Polynomial	2	0.3939	0.1744	44.29	0.1378E-01	.7739
Negative Exponential	1	0.4782	0.1520	31.78	0.1471	.8093
Half-normal	1	0.3939	0.1116	28.34	0.1507	.6371



[a]Survey block(s) and best fit model.

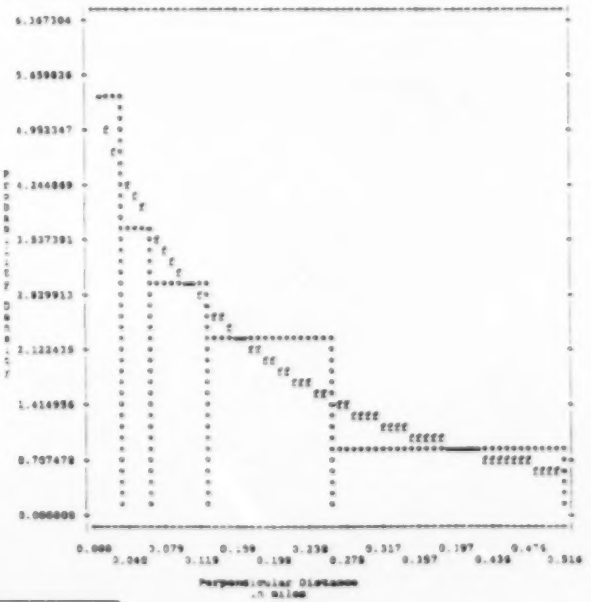
Survey Block 6B: Half-normal Estimator[a]

Estimator Name	No. Par.	Density Estimate	Standard Error	% Coef. Var.	95 Percent Confidence Interval	
Fourier Series	2	1.255	0.2946	23.47	0.5757	1.934
Exponential Power Series	2	1.241	0.3255	26.23	0.4902	1.991
Exponential Polynomial	2	1.240	0.4111	33.15	0.2921	2.188
Negative Exponential	1	1.538	0.3416	22.20	0.7507	2.326
Half-normal	1	1.240	0.2366	19.08	0.6945	1.786



Survey Block 7A: Exponential Power Series Estimator[a]

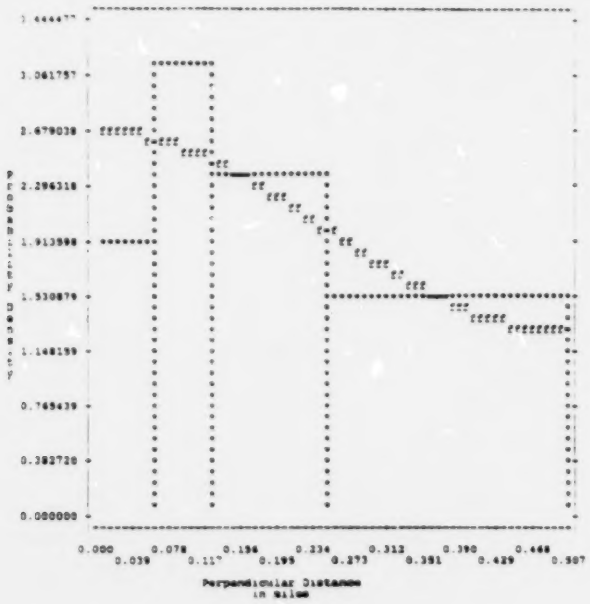
Estimator Name	No. Par.	Density Estimate	Standard Error	% Coef. Var.	95 Percent Confidence Interval	
Fourier Series	3	1.194	0.2530	21.19	0.6516	1.737
Exponential Power Series	2	1.390	0.5136	36.96	0.2881	2.491
Exponential Polynomial	2	1.211	0.1614	13.33	0.8646	1.557
Negative Exponential	1	1.211	0.2153	17.78	0.7490	1.673
Half-normal	1	0.8953	0.1394	15.57	0.5963	1.194



[a]Survey block(s) and best fit model.

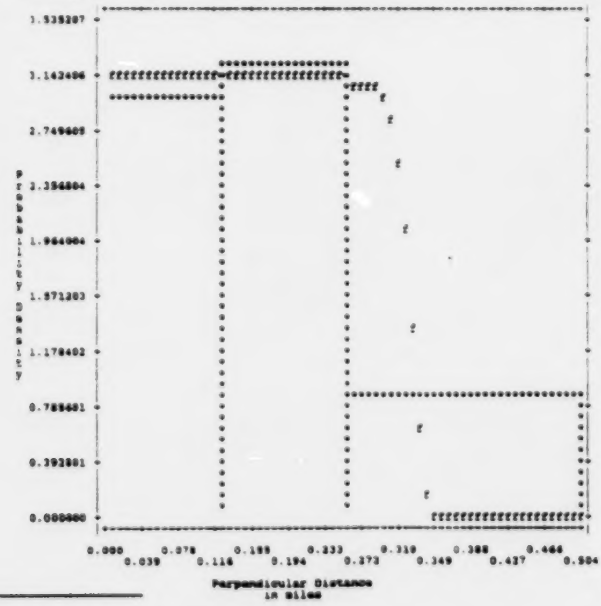
Survey Blocks 9A and 9B: Fourier Series Estimator (parameters= 1)[a]

Parameter	Point Estimate	Standard Error	Percent Coef. of Variation	95 Percent Confidence Interval	
A(01)	0.6978	0.2580	37.0	0.1920	1.203
F(0)	2.671	0.2580	9.7	2.165	3.177
D	0.5718	0.9223E-01	16.1	0.3762	0.7673



Survey Block 10: Exponential Power Series Estimator[a]

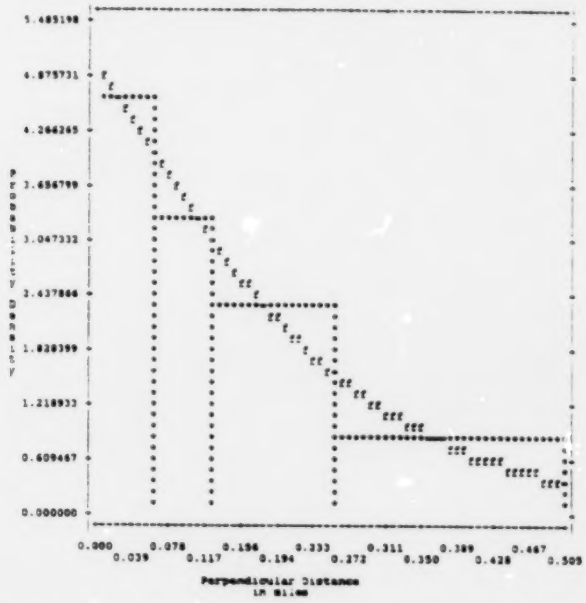
Estimator Name	No. Par.	Density Estimate	Standard Error	% Coef. Var.	95 Percent Confidence Interval	
Fourier Series	1	0.5426	0.9355E-01	17.24	0.3137	.7715
Exponential Power Series	2	0.4563	0.1104	24.19	0.1862	.7263
Exponential Polynomial	2	0.5405	0.2801	51.83	-.1450	1.226
Negative Exponential	1	0.6694	0.1771	26.46	0.2360	1.103
Half-normal	1	0.5405	0.1077	19.92	0.2771	.8040



[a]Survey block(s) and best fit model.

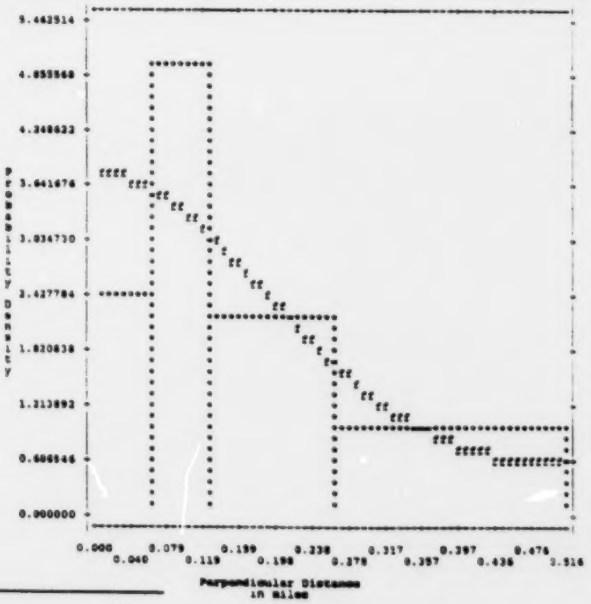
Survey Block 11: **Exponential Power Series Estimator**[a]

Estimator Name	No. Par.	Density Estimate	Standard Error	% Coef. Var.	95 Percent Confidence Interval	
Fourier Series	2	0.5977	0.1901	31.80	0.1325	1.063
Exponential Power Series	2	0.6767	0.3371	49.82	-.1482	1.502
Exponential Polynomial	2	0.6924	0.3093	44.67	-.6450E-01	1.449
Negative Exponential	1	0.7419	0.2377	32.04	0.1602	1.324
Half-normal	1	0.5452	0.1527	28.01	0.1715	.9189



Survey Blocks 14A, 14B and 14C: **Fourier Series Estimator (parameters = 2)**[a]

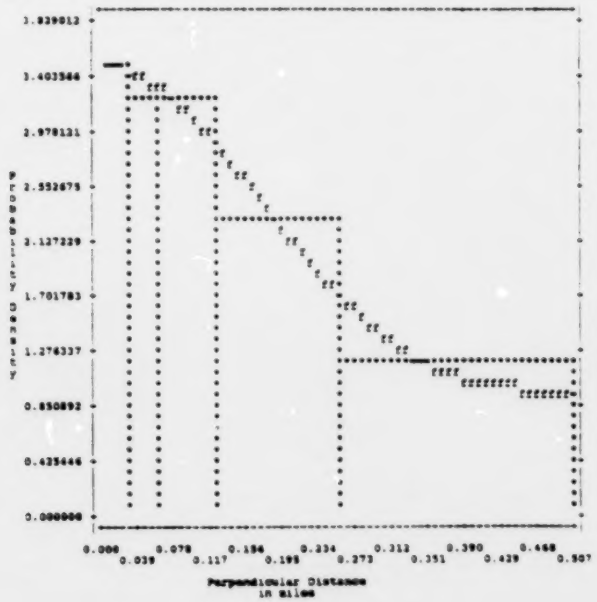
Parameter	Point Estimate	Standard Error	Percent Coef. of Variation	95 Percent Confidence Interval	
A(01)	1.593	0.5195	32.6	0.5744	2.611
A(02)	0.2298	1.023	445.3	-1.776	2.235
F(0)	3.762	1.095	29.1	1.616	5.909
D	0.2099	0.8358E-01	39.8	0.3067E-01	0.3892



[a]Survey block(s) and best fit model.

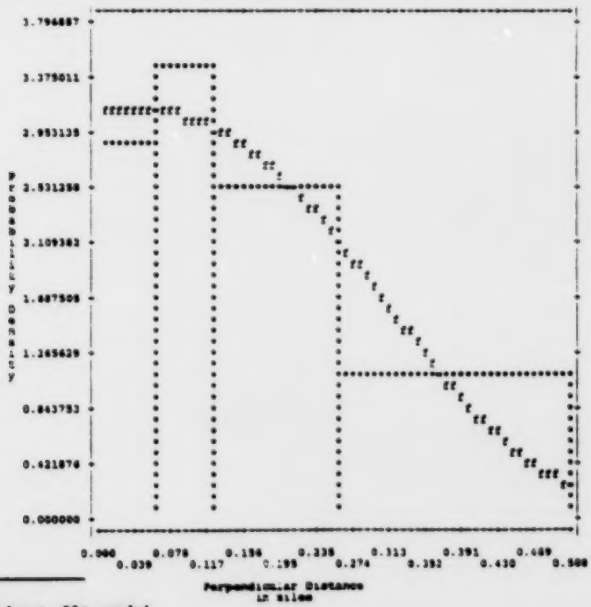
High Density Area: **Fourier Series Estimator (parameters = 2)[a]**

Estimator Name	No. Par.	Density Estimate	Standard Error	% Coef. Var.	95 Percent Confidence Interval	
Fourier Series	2	1.318	0.9602E-01	7.29	1.127	1.509
Exponential Power Series	2	1.349	0.1282	9.50	1.094	1.605
Exponential Polynomial	2	1.378	0.1350	9.80	1.109	1.647
Negative Exponential	1	1.524	0.1072	7.03	1.311	1.738
Half-normal	1	1.233	0.7606E-01	6.17	1.081	1.385



Moderate Density Area: **Exponential Power Series Estimator[a]**

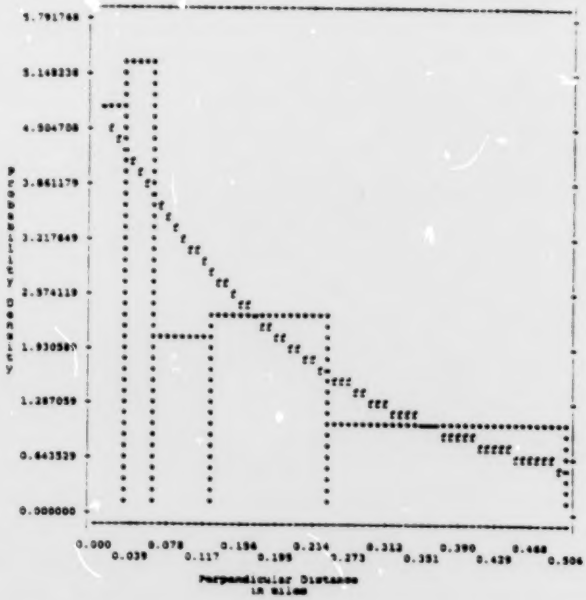
Estimator Name	No. Par.	Density Estimate	Standard Error	% Coef. Var.	95 Percent Confidence Interval	
Fourier Series	1	0.3960	0.4837E-01	12.22	0.2984	.4935
Exponential Power Series	2	0.3716	0.5944E-01	16.00	0.2517	.4915
Exponential Polynomial	2	0.3946	0.8849E-01	22.42	0.2162	.5731
Negative Exponential	1	0.4791	0.7181E-01	14.99	0.3342	.6239
Half-normal	1	0.3946	0.5054E-01	12.81	0.2927	.4966



[a]Survey block(s) and best fit model.

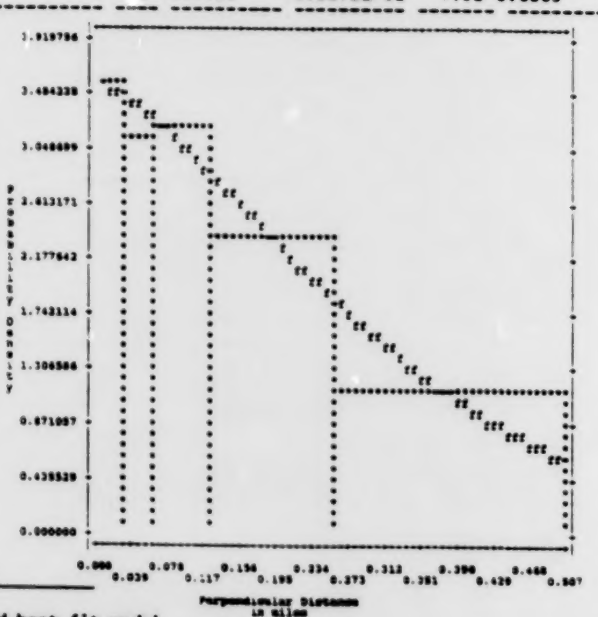
Low Density Area: **Exponential Polynomial Estimator[a]**

Estimator Name	No. Par.	Density Estimate	Standard Error	% Coef. Var.	95 Percent Confidence Interval
Fourier Series	2	0.1617	0.4310E-01	26.66	0.7410E-01 .2493
Exponential Power Series	2	0.2265	0.1274	56.25	-.3238E-01 .4853
Exponential Polynomial	2	0.1951	0.3882E-01	19.89	0.1163 .2740
Negative Exponential	1	0.1951	0.5160E-01	26.44	0.9029E-01 .3000
Half normal	1	0.1462	0.3392E-01	23.20	0.7734E-01 .2152



All Surveys Combined: **Exponential Power Series Estimator[a]**

Estimator Name	No. Par.	Density Estimate	Standard Error	% Coef. Var.	95 Percent Confidence Interval
Fourier Series	2	0.8184	0.6635E-01	8.11	0.7128 .9239
Exponential Power Series	2	0.8370	0.7977E-01	9.53	0.7102 .9639
Exponential Polynomial	2	0.8538	0.8536E-01	10.00	0.7181 .9895
Negative Exponential	1	0.9621	0.7607E-01	7.91	0.8412 1.083
Half-normal	1	0.7766	0.5678E-01	7.31	0.6863 .8669



[a]Survey block(s) and best fit model.

Appendix III. Adult pronghorn antelope population estimates by wildlife management zone, June 1990[a].

WMZ	Density Range[b]	Area[c] (km^2)	Population Estimate	Lower Limit	Upper Limit
1	Moderate	976	251	170	331
	Low	5,610	623	370	875
	Zone Total	6,586	874	540	1,206
	WMZ Estimate Based on Survey Block only		973	48	1,902
2	High	8,399	6,788	5,804	7,771
	Moderate	2,056	528	358	698
	Zone Total	10,455	7,316	6,162	8,469
	WMZ Estimate Based on Survey Block only		8,925	48	1,902
3	High	4,476	3,618	3,093	4,142
	Zone Total	4,476	3,618	3,093	4,142
	WMZ Estimate Based on Survey Block only		4,089	2,701	5,476
4	Moderate	2,587	664	550	878
	Low	3,970	441	262	619
	Zone Total	6,557	1,105	812	1,497
	WMZ Estimate Based on Survey Block only		1,484	420	2,544
5	Moderate	5,723	1,469	995	1,943
	Low	290	32	19	45
	Zone Total	6,013	1,501	1,014	1,988
	WMZ Estimate Based on Survey Block only		1,264	508	2,024
6	High	1,186	959	820	1,098
	Moderate	3,333	856	580	1,132
	Zone Total	4,519	1,815	1,400	2,230
	WMZ Estimate Based on Survey Block only		3,070	1,721	4,422
7	High	1,419	1,147	981	1,313
	Moderate	335	86	58	114
	Zone Total	1,754	1,233	1,039	1,427
	WMZ Estimate Based on Survey Block only		1,673	347	2,297
8	High	919	743	635	850
	Moderate	2,546	653	443	864
	Zone Total	3,465	1,396	1,078	1,714
9	High	792	640	548	850
	Moderate	2,750	706	478	864
	Zone Total	3,542	1,346	1,026	1,667
	WMZ Estimate Based on Survey Block only		1,700	1,118	2,280

10	Moderate	3,012	773	524	1,023
	Zone Total	3,012	773	524	1,023
	WMZ Estimate Based on Survey Block only		987	403	1,572
11	Moderate	1,057	271	184	359
	Zone Total	1,057	271	184	359
	WMZ Estimate Based on Survey Block only		534	74	1,185
12	Moderate	308	79	54	105
	Zone Total	308	79	54	105
13	Moderate	3,144	807	547	1,067
	Low	873	97	58	136
	Zone Total	4,017	904	605	1,203
14	Moderate	420	108	73	142
	Low	3,864	429	255	603
	Zone Total	4,284	537	328	745
	WMZ Estimate Based on Survey Block only		731	108	1,354
15	Range Extension	N/A	185	N/A	N/A
	Zone Total	N/A	185	N/A	N/A
18	Range Extension	N/A	50	N/A	N/A
	Zone Total	N/A	50	N/A	N/A
19	Low	2,072	230	137	323
	Range Extension	N/A	175	N/A[d]	N/A[d]
	Zone Total	2,072+	405	312[d]	498[d]
23	Range Extension	N/A	155	N/A	N/A
	Zone Total	N/A	155	N/A	N/A
24	Low	1,626	181	107	254
	Range Extension	N/A	175	N/A[d]	N/A[d]
	Zone Total	1,626+	356	282[d]	429[d]
25	Low	1,243	138	82	194
	Range Extension	N/A	240	N/A[d]	N/A[d]
	Zone Total	1,243+	378	322[d]	434[d]
26	Low	119	13	8	19
	Range Extension	N/A	80	N/A[d]	N/A[d]
	Zone Total	119+	93	88[d]	99[d]
27	Range Extension	N/A	200	N/A	N/A
	Zone Total	N/A	200	N/A	N/A

28	Range Extension	N/A	55	N/A	N/A
	Zone Total	N/A	55	N/A	N/A
31	Range Extension	N/A	25	N/A	N/A
	Zone Total	N/A	25	N/A	N/A
45	Range Extension	N/A	50	N/A	N/A
	Zone Total	N/A	50	N/A	N/A
ESTIMATED ADULT POPULATION		25140+	24,720	19,583[d]	29,955[d]

[a] Refer to Figure 4.

[b] High, Moderate and low density ranges are within Dirschl's (1960) range; Range Extension was the estimate of fringe herd numbers as supplied by SNR field staff.

[c] Potential pronghorn antelope habitat, only.

[d] Sum of either lower or upper limit plus Range Extension estimate.

Appendix IV. **Frequency table, per cent occupied, adequate quadrat sample and population estimates for provincial antelope surveys.**

All Survey Blocks combined:

Number of Antelope (Frequency)	Land Classifications					
	Class 1	Class 2	Class 3	Class 4	Class 5	Total
0	530	268	215	526	286	1,825
1	176	66	39	65	38	384
2	81	38	11	22	11	163
3	54	17	9	11	6	97
4	41	12	4	6	2	65
5	25	4	2	3	0	34
6	24	3	1	2	0	30
7	11	1	1	2	1	16
8	7	1	1	1	0	10
9	7	3	2	2	0	14
10	7	0	0	1	0	8
11	3	2	0	0	0	5
12	5	1	0	0	0	6
13	2	0	0	0	0	2
14	1	0	0	0	0	1
15	0	2	0	0	0	2
19	1	0	0	0	0	1
21	1	0	0	0	0	1
25	1	0	0	0	0	1
Sampled (n)	977	418	285	641	344	2,665
Survey Total (N)	2,400	1,031	630	1,465	687	6,213
WMZ 1-7, 9-11 & 14 Total (N)	4,201	2,517	1,996	5,860	5,566	20,140
Provincial Total (N)	5,082	3,066	2,481	6,908	7,565	25,102
Mean	1.43	0.92	0.54	0.38	0.27	
Variance	6.58	3.85	1.78	1.29	0.56	
Percent of Land Class which was occupied by 1 or more animals	46%	36%	25%	18%	17%	
Adequate sample required for population estimate based on surveys' Variance (B= 0.1; P≤ 0.05)	703	324	177	422	304	1,930

Population Estimates: (at P≤ 0.05)

Line Transect Technique

1) Survey Blocks = 8,503 Range: 7,213 to 9,793
2) Historic Range = 34,218 Range: 29,026 to 39,410

Stratified Block Technique

1) Survey Blocks = 5,463 +/- 356 or 6.5%
Range: 5,107 to 5,819
2) WMZ 1-7, 9-11 & 14 = 13,131 +/- 1,019 or 7.8%
Range: 12,112 to 14,150
3) Historic Range = 16,095 +/- 1,278 or 7.9%
Range: 14,817 to 17,373

Survey Block 1A:

Number of Antelope (Frequency)	Land Classifications					
	Class 1	Class 2	Class 3	Class 4	Class 5	Total
0	56	45	41	58	1	201
1	2	2	1	1	0	6
2	1	1	1	0	0	3
3	1	0	0	0	0	1
4	1	0	0	0	0	1
Sampled (n)	61	48	43	59	1	212
Survey Total (N)	191	133	115	197	1	637
WMZ 1 Total (N)	405	354	425	817	524	2,525
Mean	0.18	0.08	0.07	0.02	0.00	
Variance	0.48	0.12	0.11	0.02	0.00	
Percent of Land Class which was occupied by 1 or more animals	8%	6%	5%	2%	0%	
Adequate sample required for WMZ pop. estimate based on survey Variance (B= 0.1; P≤ 0.05)	405[a]	227	261	214	0	1,107

Population Estimates: (at P≤ 0.05)

Line Transect Technique

1) Survey Block = 250 Range: 12[b] to 489
2) WMZ 1 = 973 Range: 48 to 1,902

Stratified Block Technique

1) Survey Block = 57 +/- 32 or 55.5%
Range: 25 to 89
2) WMZ 1 = 147 +/- 88 or 59.9%
Range: 59 to 235

[a] Would require 100% coverage.

[b] There was a total of 19 animals observed on survey transects.

Survey Blocks 2A, 2B and 2C:

Number of Antelope (Frequency)	Land Classifications					
	Class 1	Class 2	Class 3	Class 4	Class 5	Total
0	111	52	18	38	3	222
1	52	12	6	15	3	88
2	24	5	3	4	2	38
3	20	5	2	0	0	27
4	9	5	2	0	0	16
5	7	2	1	0	0	10
6	10	0	0	0	0	10
7	5	0	0	2	0	7
8	3	0	0	0	0	3
9	1	0	0	0	0	1
10	4	0	0	0	0	4
11	1	1	0	0	0	2
12	2	0	0	0	0	2
19	1	0	0	0	0	1
Sampled (n)	250	82	32	59	8	431
Survey Total (N)	832	299	116	199	25	1,471
WMZ 2 Total (N)	1,274	713	389	943	733	4,052
Mean	1.80	0.95	0.97	0.63	0.88	
Variance	7.45	3.10	1.97	1.79	0.61	
Percent of Land Class which was occupied by 1 or more animals	56%	37%	44%	36%	63%	
Adequate sample required for WMZ pop. estimate based on survey Variance (B= 0.1; P≤ 0.05)	357	129	56	129	59	730

Population Estimates: (at P≤ 0.05)

Line Transect Technique

1) Survey Blocks = 3,222 Range: 2,423 to 4,021
2) WMZ 2 = 8,925 Range: 6,712 to 11,138

Stratified Block Technique

1) Survey Blocks = 2,042 +/- 266 or 13.0%
Range: 1,776 to 2,308

2) WMZ 2 = 4,587 +/- 720 or 15.7%
Range: 3,867 to 5,307

Survey Block 3A:

Number of Antelope (Frequency)	Land Classifications					
	Class 1	Class 2	Class 3	Class 4	Class 5	Total
0	57	30	28	46	8	169
1	42	24	11	8	0	85
2	19	12	3	3	0	37
3	11	5	4	2	0	22
4	14	3	1	2	0	20
5	10	2	1	0	0	13
6	8	1	0	0	0	9
7	2	0	0	0	1	3
8	2	1	0	1	0	4
9	4	2	1	0	0	7
10	1	0	0	0	0	1
11	2	0	0	0	0	2
12	1	0	0	0	0	1
13	1	0	0	0	0	1
14	1	0	0	0	0	1
15	0	1	0	0	0	1
21	1	0	0	0	0	1
25	1	0	0	0	0	1
Sampled (n)	177	81	49	62	9	378
Survey Total (N)	467	215	126	120	20	948
WMZ 3 Total (N)	678	316	201	235	302	1,732
Mean	2.52	1.62	0.94	0.58	0.78	
Variance	12.73	6.01	2.66	1.82	4.84	
Percent of Land Class which was occupied by 1 or more animals	68%	63%	44%	26%	11%	
Adequate sample required for WMZ pop. estimate based on survey Variance (B= 0.1; P≤ 0.05)	329	105	45	43	90	612

Population Estimates: (at P≤ 0.05)

Line Transect Technique

1) Survey Block = 2,235 Range: 1,476 to 2,992
2) WMZ 3 = 4,089 Range: 2,701 to 5,476

Stratified Block Technique

1) Survey Block = 1,729 +/- 220 or 12.8%
Range: 1,509 to 1,949

2) WMZ 3 = 2,781 +/- 586 or 21.1%
Range: 2,195 to 3,367

Survey Block 4:

Number of Antelope (Frequency)	Land Classifications					
	Class 1	Class 2	Class 3	Class 4	Class 5	Total
0	1	5	16	122	61	205
1	0	2	0	11	7	20
2	0	0	0	2	0	2
3	0	0	0	3	1	4
4	0	0	0	1	0	1
6	0	0	0	1	0	1
9	0	0	0	1	0	1
Sampled (n)	1	7	16	141	69	234
Survey Block Total (N)	1	11	29	302	143	486
WMZ 4 Total (N)	1	42	134	1,400	939	2,516
Mean	0.00	0.29	0.00	0.30	0.14	
Variance	0.00	0.20	0.00	1.18	0.21	
Percent of Land Class which was occupied by 1 or more animals	0%	29%	0%	13%	12%	
Adequate sample required for WMZ pop. estimate based on survey Variance (B= 0.1; Ps 0.05)	0	14	0	1,116	316	1,446

Population Estimates: (at Ps 0.05)

Line Transect Technique

1) Survey Block = 287 Range: 81 to 491

2) WMZ 4 = 1,484 Range: 420 to 2,544

Stratified Block Technique

1) Survey Block = 114 +/- 41 or 36.4%
Range: 73 to 155

2) WMZ 4 = 564 +/- 259 or 46.0%
Range: 305 to 823

Survey Block 5:

Number of Antelope (Frequency)	Land Classifications					
	Class 1	Class 2	Class 3	Class 4	Class 5	Total
0	0	15	19	101	57	192
1	0	0	2	11	8	21
2	0	0	1	5	3	9
3	0	0	0	3	1	4
4	0	0	0	3	1	4
5	0	0	0	1	0	1
6	0	0	0	1	0	1
9	0	0	0	1	0	1
10	0	0	0	1	0	1
Sampled (n)	0	15	22	127	70	234
Survey Block Total (N)	2	30	42	269	143	486
WMZ 5 Total (N)	21	111	186	1,083	921	2,322
Mean	0.00	0.00	0.18	0.57	0.30	
Variance	0.00	0.00	0.24	2.42	0.55	
Percent of Land Class which was occupied by 1 or more animals	0%	0%	14%	20%	19%	
Adequate sample required for WMZ pop. estimate based on survey variance (B= 0.1; P≤ 0.05)	0	0	41	766	310	1,117

Population Estimates: (at P≤ 0.05)

Line Transect Technique

1) Survey Block = 265 Range: 106 to 424

2) WMZ 5 = 1,264 Range: 508 to 2,024

Stratified Block Technique

1) Survey Block = 204 +/- 57 or 27.7%
Range: 147 to 261

2) WMZ 5 = 927 +/- 319 or 34.5%
Range: 608 to 1,246

Survey Block 68:

Number of Antelope (Frequency)	Land Classifications					
	Class 1	Class 2	Class 3	Class 4	Class 5	Total
0	26	18	10	5	0	59
1	13	11	3	1	0	28
2	4	6	2	0	0	12
3	5	2	0	0	0	7
4	1	1	1	0	0	3
5	1	0	0	0	0	1
6	1	1	0	0	0	2
7	2	0	0	0	0	2
12	0	1	0	0	0	1
Sampled (n)	53	40	16	6	0	115
Survey Block Total (N)	103	72	27	13	0	215
UMZ 6 Total (N)	423	469	237	435	180	1,744
Mean	1.23	1.28	0.69	0.17	0.00	
Variance	3.19	4.60	1.21	0.14	0.00	
Percent of Land Class which was occupied by 1 or more animals	51%	55%	38%	17%	0%	
Adequate sample required for UMZ pop. estimate based on survey variance (B= 0.1; P≤ 0.05)	191	254	56	41	0	552

Population Estimates: (at P≤ 0.05)

Line Transect Technique

1) Survey Block = 380 Range: 213 to 547

2) UMZ 6 = 3,070 Range: 1,721 to 4,422

Stratified Block Technique

1) Survey Block = 240 +/- 49 or 20.3%
Range: 191 to 289

2) UMZ 6 = 1,358 +/- 402 or 29.6%
Range: 956 to 1,760

Survey Block 7A:

Number of Antelope (Frequency)	Land Classifications					
	Class 1	Class 2	Class 3	Class 4	Class 5	Total
0	102	27	21	18	0	168
1	29	5	10	5	0	49
2	9	8	0	2	0	19
3	7	4	2	0	0	13
4	4	1	0	0	0	5
5	4	0	0	0	0	
6	1	1	1	0	0	3
7	1	0	0	0	0	1
9	0	1	0	0	0	1
12	1	0	0	0	0	1
13	1	0	0	0	0	1
Sampled (n)	159	47	34	25	0	265
Survey Block Total (N)	301	94	63	54	0	512
WMZ 7 Total (N)	376	119	75	77	30	677
Mean	0.89	1.11	0.65	0.36	0.00	
Variance	3.54	3.16	1.46	0.39	0.00	
Percent of Land Class which was occupied by 1 or more animals	36%	43%	38%	28%	0%	
Adequate sample required for WMZ pop. estimate based on survey Variance (B= 0.1; P≤ 0.05)	286	86	37	19	0	428

Population Estimates: (at P≤ 0.05)

Line Transect Technique

1) Survey Block = 1,265 Range: 262 to 2,267

2) WMZ 7 = 1,673 Range: 347 to 2,997

Stratified Block Technique

1) Survey Block = 433 +/- 72 or 16.7%
Range: 361 to 505

2) WMZ 7 = 543 +/- 100 or 18.4%
Range: 443 to 643

Survey Block 9A and 9B:

Number of Antelope (Frequency)	Land Classifications					
	Class 1	Class 2	Class 3	Class 4	Class 5	Total
0	81	30	29	50	12	202
1	27	7	5	5	4	48
2	17	5	0	2	0	24
3	6	0	1	1	0	8
4	9	0	0	0	0	9
5	3	0	0	1	0	4
6	3	0	0	0	0	3
7	1	1	0	0	0	2
8	2	0	0	0	0	2
9	1	0	0	0	0	1
10	1	0	0	0	0	1
12	1	0	0	0	0	1
15	0	1	0	0	0	1
Sampled (n)	152	44	35	59	16	306
Survey Block Total (N)	293	79	59	116	30	577
WMZ 9 Total (N)	481	168	156	367	196	1,368
Mean	1.33	0.89	0.23	0.29	0.25	
Variance	4.67	6.06	0.35	0.71	0.19	
Percent of Land Class which was occupied by 1 or more animals	47%	32%	17%	15%	25%	
Adequate sample required for WMZ pop. estimate based on survey Variance (B= 0.1; P≤ 0.05)	330	131	29	98	27	615

Population Estimates: (at P≤ 0.05)

Line Transect Technique

1) Survey Blocks = 717 Range: 471 to 962

2) WMZ 9 = 1,700 Range: 1,118 to 2,280

Stratified Block Technique

1) Survey Blocks = 515 +/- 83 or 16.1%
Range: 432 to 598

2) WMZ 9 = 983 +/- 196 or 20.0%
Range: 787 to 1,179

Survey Block 10:

Number of Antelope (Frequency)	Land Classifications					
	Class 1	Class 2	Class 3	Class 4	Class 5	Total
0	20	1	4	21	51	97
1	4	1	1	1	6	13
2	1	1	0	1	3	6
3	2	0	0	1	2	5
4	0	0	0	0	1	1
5	0	0	0	1	0	1
6	1	0	0	0	0	1
9	1	0	1	0	0	2
Sampled (n)	29	3	6	25	63	126
Survey Block Total (N)	51	7	10	47	119	234
WMZ 10 Total (N)	194	30	58	214	667	1,163
Mean	0.93	1.00	1.67	0.44	0.35	
Variance	4.06	0.67	10.89	1.37	0.70	
Percent of Land Class which was occupied by 1 or more animals	31%	67%	33%	16%	19%	
Adequate sample required for WMZ pop. estimate based on survey Variance (B= 0.1; P≤ 0.05)	170	11	83	109	243	616

Population Estimates: (at P≤ 0.05)

Line Transect Technique

1) Survey Block = 199 Range: 81 to 316

2) WMZ 10 = 987 Range: 403 to 1,572

Stratified Block Technique

1) Survey Block = 133 +/- 38 or 28.7%
Range: 95 to 171

2) WMZ 10 = 635 +/- 262 or 41.3%
Range: 373 to 897

Survey Block 11:

Number of Antelope (Frequency)	Land Classifications					
	Class 1	Class 2	Class 3	Class 4	Class 5	Total
0	10	3	13	32	51	109
1	3	2	0	4	7	16
2	1	0	1	2	2	6
3	1	0	0	1	2	4
4	2	0	0	0	0	2
7	0	0	1	0	0	1
8	0	0	1	0	0	1
11	0	1	0	0	0	1
Sampled (n)	17	6	16	39	62	140
Survey Block Total (N)	45	10	26	67	111	259
WMZ 11 Total (N)	59	17	41	80	187	384
Mean	0.94	2.17	1.06	0.29	0.27	
Variance	1.94	15.81	6.18	0.47	0.46	
Percent of Land Class which was occupied by 1 or more animals	41%	50%	19%	18%	18%	
Adequate sample required for WMZ pop. estimate based on survey variance (B= 0.1; P≤ 0.05)	41	33	51	27	63	215

Population Estimates: (at P≤ 0.05)

Line Transect Technique

1) Survey Block = 340 Range: 74[a] to 755

2) WMZ 11 = 534 Range: 74[a] to 1,185

Stratified Block Technique

1) Survey Block = 141 +/- 41 or 29.2%
Range: 100 to 182

2) WMZ 11 = 210 +/- 76 or 36.3%
Range: 134 to 286

[a] Calculated lower bound was negative, therefore, the actual number of animals observed was used as lower range.

Survey Blocks 14A, 14B and 14C:

Number of Antelope (Frequency)	Land Classifications					
	Class 1	Class 2	Class 3	Class 4	Class 5	Total
0	66	42	16	35	42	201
1	4	0	0	3	3	10
2	5	0	0	1	1	7
3	1	1	0	0	0	2
4	1	2	0	0	0	3
10	1	0	0	0	0	1
Sampled (n)	78	45	16	39	46	224
Survey Block Total (N)	133	78	35	78	95	419
WMZ 14 Total (N)	289	179	94	209	887	1,658
Mean	0.40	0.24	0.00	0.13	0.11	
Variance	1.77	0.85	0.00	0.16	0.14	
Percent of Land Class which was occupied by 1 or more animals	16%	7%	0%	10%	9%	
Adequate sample required for WMZ pop. estimate based on survey Variance (B= 0.1; P≤ 0.05)	289[a]	155	0	78	311	833

Population Estimates: (at P≤ 0.05)

Line Transect Technique

1) Survey Blocks = 183 Range: 27[b] to 340

2) WMZ 14 = 731 Range: 108 to 1,354

Stratified Block Technique

1) Survey Block = 93 +/- 31 or 33.6%
Range: 62 to 124

2) WMZ 14 = 283 +/- 129 or 45.7%
Range: 154 to 412

[a] Would require 100% coverage.

[b] There was a total of 52 animals observed on survey transects.

Appendix V. **Summary of land classification changes from air photograph interpretation (1979-80) to actual aerial observation (1990).**

All Survey Blocks combined:

Land Classification	Original Number (mi^2) Classified on Transect by Air Photo Interpretation	Changed To:	Number of Quadrats (mi^2)	Percent that Changed	Adjusted Land Class Total
Class 1	1,202	Class 2	162	13.5%	983
		Class 3	44	3.7%	
		Class 4	15	1.2%	
		Class 5	3	0.2%	
Class 2	338	Class 1	4	1.2%	413
		Class 3	53	15.7%	
		Class 4	32	9.5%	
		Class 5	2	0.6%	
Class 3	243	Class 1	1	0.4%	271
		Class 2	3	1.2%	
		Class 4	70	28.8%	
		Class 5	4	1.6%	
Class 4	544	Class 1	0	0.0%	647
		Class 2	1	0.2%	
		Class 3	7	1.3%	
		Class 5	53	9.7%	
Class 5	331	Class 1	0	0.0%	344
		Class 2	0	0.0%	
		Class 3	2	0.6%	
		Class 4	47	14.2%	

Survey Block 1A:

Land Classification	Original Number (mi^2) Classified on Transect by Air Photo Interpretation	Changed To:	Number of Quadrats (mi^2)	Percent that Changed	Adjusted Land Class Total
Class 1	89	Class 2	16	17.9%	66
		Class 3	7	7.9%	
		Class 4	2	2.2%	
		Class 5	0	0.0%	
Class 2	56	Class 1	2	3.6%	46
		Class 3	14	25.0%	
		Class 4	10	17.9%	
		Class 5	0	0.0%	
Class 3	28	Class 1	0	0.0%	41
		Class 2	0	0.0%	
		Class 4	8	28.6%	
		Class 5	0	0.0%	
Class 4	39	Class 1	0	0.0%	59
		Class 2	0	0.0%	
		Class 3	0	0.0%	
		Class 5	0	0.0%	
Class 5	1	Class 1	0	0.0%	1
		Class 2	0	0.0%	
		Class 3	0	0.0%	
		Class 4	0	0.0%	

Survey Blocks 2A, 2B and 2C:

Land Classification	Original Number (mi^2) Classified on Transect by Air Photo Interpretation	Changed To:	Number of Quadrats (mi^2)	Percent that Changed	Adjusted Land Class Total
Class 1	287	Class 2	28	9.8%	253
		Class 3	5	1.7%	
		Class 4	1	0.3%	
		Class 5	0	0.0%	
Class 2	56	Class 1	0	0.0%	81
		Class 3	3	5.4%	
		Class 4	1	1.8%	
		Class 5	0	0.0%	
Class 3	22	Class 1	0	0.0%	27
		Class 2	0	0.0%	
		Class 4	6	27.3%	
		Class 5	0	0.0%	
Class 4	56	Class 1	0	0.0%	60
		Class 2	1	1.8%	
		Class 3	3	5.4%	
		Class 5	3	5.4%	
Class 5	7	Class 1	0	0.0%	7
		Class 2	0	0.0%	
		Class 3	0	0.0%	
		Class 4	3	57.1%	

Survey Block 3A:

Land Classification	Original Number (mi^2) Classified on Transect by Air Photo Interpretation	Changed To:	Number of Quadrats (mi^2)	Percent that Changed	Adjusted Land Class Total
Class 1	228	Class 2	38	16.6%	175
		Class 3	12	5.3%	
		Class 4	2	0.9%	
		Class 5	1	0.4%	
Class 2	51	Class 1	0	0.0%	80
		Class 3	8	15.7%	
		Class 4	3	5.9%	
		Class 5	0	0.0%	
Class 3	40	Class 1	0	0.0%	49
		Class 2	2	5.0%	
		Class 4	9	22.5%	
		Class 5	1	2.5%	
Class 4	51	Class 1	0	0.0%	62
		Class 2	0	0.0%	
		Class 3	1	2.0%	
		Class 5	2	3.9%	
Class 5	5	Class 1	0	0.0%	9
		Class 2	0	0.0%	
		Class 3	0	0.0%	
		Class 4	0	0.0%	

Survey Block 4:

Land Classification	Original Number (mi^2) Classified on Transect by Air Photo Interpretation	Changed To:	Number of Quadrats (mi^2)	Percent that Changed	Adjusted Land Class Total
Class 1	2	Class 2	0	0.0%	0
		Class 3	1	50.0%	
		Class 4	0	0.0%	
		Class 5	1	50.0%	
Class 2	13	Class 1	0	0.0%	7
		Class 3	1	7.7%	
		Class 4	4	30.8%	
		Class 5	1	7.7%	
Class 3	21	Class 1	0	0.0%	13
		Class 2	0	0.0%	
		Class 4	12	57.1%	
		Class 5	1	4.8%	
Class 4	121	Class 1	0	0.0%	141
		Class 2	0	0.0%	
		Class 3	2	1.7%	
		Class 5	6	5.0%	
Class 5	73	Class 1	0	0.0%	69
		Class 2	0	0.0%	
		Class 3	1	1.4%	
		Class 4	12	16.4%	

Survey Block 5:

Land Classif.cation	Original Number (mi^2) Classified on Transect by Air Photo Interpretation	Changed To:	Number of Quadrats (mi^2)	Percent that Changed	Adjusted Land Class Total
Class 1	0	Class 2	0	0.0%	0
		Class 3	0	0.0%	
		Class 4	0	0.0%	
		Class 5	0	0.0%	
Class 2	17	Class 1	0	0.0%	15
		Class 3	2	11.7%	
		Class 4	0	0.0%	
		Class 5	0	0.0%	
Class 3	27	Class 1	0	0.0%	22
		Class 2	0	0.0%	
		Class 4	8	29.6%	
		Class 5	0	0.0%	
Class 4	105	Class 1	0	0.0%	131
		Class 2	0	0.0%	
		Class 3	0	0.0%	
		Class 5	3	2.9%	
Class 5	90	Class 1	0	0.0%	71
		Class 2	0	0.0%	
		Class 3	1	1.1%	
		Class 4	21	23.3%	

Survey Block 68:

Land Classification	Original Number (mi^2) Classified on Transect by Air Photo Interpretation	Changed To:	Number of Quadrats (mi^2)	Percent that Changed	Adjusted Land Class Total
Class 1	79	Class 2	19	24.1%	54
		Class 3	6	7.6%	
		Class 4	0	0.0%	
		Class 5	0	0.0%	
Class 2	26	Class 1	0	0.0%	40
		Class 3	2	7.7%	
		Class 4	3	11.5%	
		Class 5	0	0.0%	
Class 3	10	Class 1	0	0.0%	16
		Class 2	0	0.0%	
		Class 4	2	20.0%	
		Class 5	0	0.0%	
Class 4	1	Class 1	0	0.0%	6
		Class 2	0	0.0%	
		Class 3	0	0.0%	
		Class 5	0	0.0%	
Class 5	0	Class 1	0	0.0%	0
		Class 2	0	0.0%	
		Class 3	0	0.0%	
		Class 4	0	0.0%	

Survey Block 7A:

Land Classification	Original Number (mi^2) Classified on Transect by Air Photo Interpretation	Changed To:	Number of Quadrats (mi^2)	Percent that Changed	Adjusted Land Class Total
Class 1	188	Class 2	20	10.6%	162
		Class 3	6	3.2%	
		Class 4	0	0.0%	
		Class 5	0	0.0%	
Class 2	33	Class 1	0	0.0%	44
		Class 3	6	18.2%	
		Class 4	3	9.1%	
		Class 5	0	0.0%	
Class 3	25	Class 1	0	0.0%	31
		Class 2	0	0.0%	
		Class 4	6	24.0%	
		Class 5	0	0.0%	
Class 4	13	Class 1	0	0.0%	22
		Class 2	0	0.0%	
		Class 3	0	0.0%	
		Class 5	0	0.0%	
Class 5	2	Class 1	0	0.0%	2
		Class 2	0	0.0%	
		Class 3	0	0.0%	
		Class 4	0	0.0%	

Survey Blocks 9A and 9B:

Land Classification	Original Number (mi^2) Classified on Transect by Air Photo Interpretation	Changed To:	Number of Quadrats (mi^2)	Percent that Changed	Adjusted Land Class Total
Class 1	169	Class 2	11	6.5%	149
		Class 3	5	3.0%	
		Class 4	5	3.0%	
		Class 5	1	0.6%	
Class 2	46	Class 1	2	4.3%	45
		Class 3	9	19.6%	
		Class 4	2	4.3%	
		Class 5	0	0.0%	
Class 3	30	Class 1	0	0.0%	34
		Class 2	1	3.3%	
		Class 4	9	30.0%	
		Class 5	0	0.0%	
Class 4	38	Class 1	0	0.0%	57
		Class 2	0	0.0%	
		Class 3	0	0.0%	
		Class 5	2	5.3%	
Class 5	18	Class 1	0	0.0%	16
		Class 2	0	0.0%	
		Class 3	0	0.0%	
		Class 4	5	27.8%	

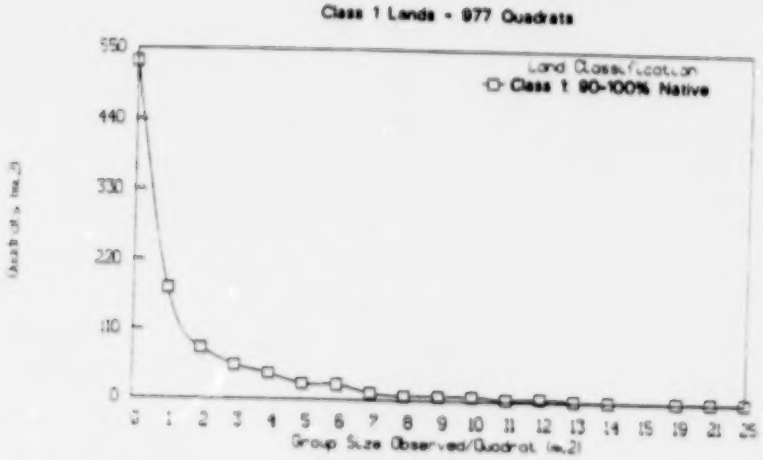
Survey Blocks 10 and 11:

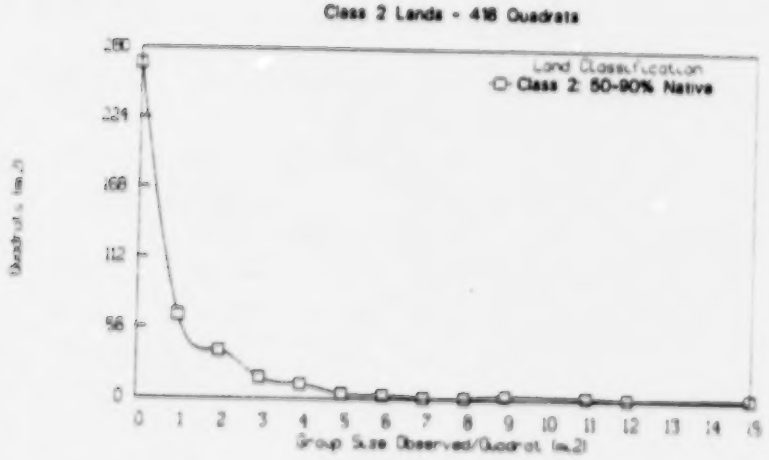
Land Classification	Original Number (mi^2) Classified on Transect by Air Photo Interpretation	Changed To:	Number of Quadrats (mi^2)	Percent that Changed	Adjusted Land Class Total
Class 1	48	Class 2	1	2.1%	45
		Class 3	2	4.2%	
		Class 4	0	0.0%	
		Class 5	0	0.0%	
Class 2	11	Class 1	0	0.0%	8
		Class 3	3	27.3%	
		Class 4	1	9.1%	
		Class 5	0	0.0%	
Class 3	22	Class 1	0	0.0%	21
		Class 2	0	0.0%	
		Class 4	7	31.8%	
		Class 5	0	0.0%	
Class 4	77	Class 1	0	0.0%	67
		Class 2	0	0.0%	
		Class 3	1	1.3%	
		Class 5	23	29.9%	
Class 5	106	Class 1	0	0.0%	123
		Class 2	0	0.0%	
		Class 3	0	0.0%	
		Class 4	6	5.7%	

Survey Blocks 14A, 14B and 14C:

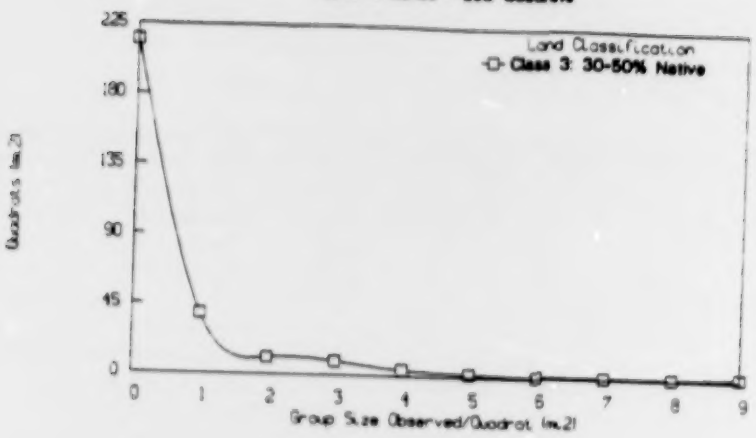
Land Classification	Original Number (mi^2) Classified on Transect by Air Photo Interpretation	Changed To:	Number of Quadrats (mi^2)	Percent that Changed	Adjusted Land Class Total
Class 1	112	Class 2	29	25.9%	79
		Class 3	0	0.0%	
		Class 4	5	4.5%	
		Class 5	0	0.0%	
Class 2	29	Class 1	0	0.0%	47
		Class 3	5	17.2%	
		Class 4	5	17.2%	
		Class 5	1	3.4%	
Class 3	18	Class 1	1	5.6%	17
		Class 2	0	0.0%	
		Class 4	3	16.7%	
		Class 5	2	11.1%	
Class 4	43	Class 1	0	0.0%	42
		Class 2	0	0.0%	
		Class 3	0	1.3%	
		Class 5	14	32.6%	
Class 5	29	Class 1	0	0.0%	46
		Class 2	0	0.0%	
		Class 3	0	0.0%	
		Class 4	0	0.0%	

Appendix VI. **Antelope frequency graph for five land classifications.**

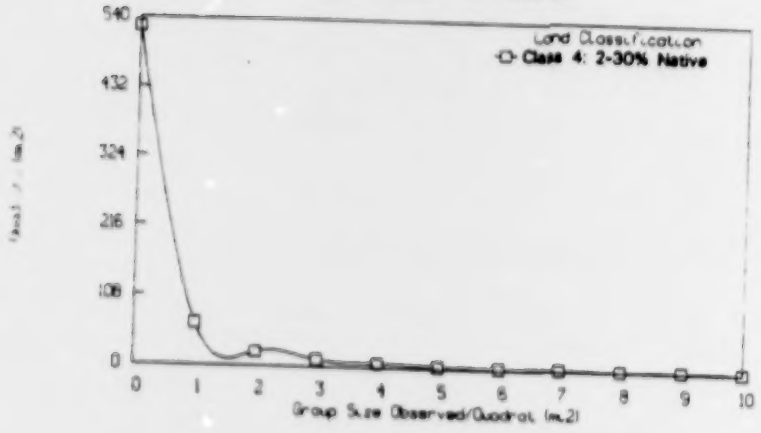




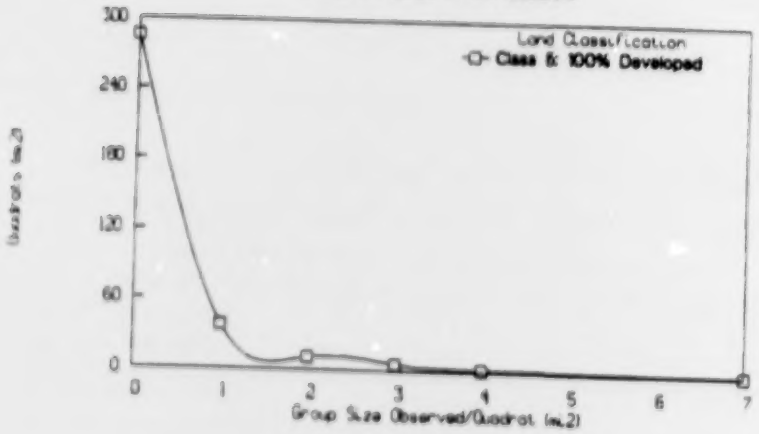
Class 3 Lands - 288 Quadrats



Class 4 Lands - 841 Quadrats



Class 6 Lands - 344 Quadrats



Appendix VII: Observed, expected and confidence intervals of antelope in relation to land use. Tested by Bonferroni "z" statistic.

All Survey Blocks, combined:

z = (1-a)/2(k) = (1-.95)/2(5) = 0.005; Tabular z = 2.57

P ≤ 0.05

Land Type	Area	p1 of Area	Observed	Expected	p2 observed	Conf. Int on p2	Comments
Class 1	977	0.367	1,397	832.558	0.615	.589<p2<.641	p1 < p2; selected
Class 2	418	0.157	385	356.202	0.170	.150<p2<.190	p1 = p2; no selection
Class 3	285	0.107	153	242.865	0.067	.054<p2<.080	p1 > p2; avoided
Class 4	641	0.241	243	546.233	0.107	.090<p2<.124	p1 > p2; avoided
Class 5	344	0.129	93	293.142	0.041	.030<p2<.052	p1 > p2; avoided
Total	2,665		2,271	2,271.000			

Predominately Native Land Classifications: Surveys 2A, 2B, 2C, 3A, 6B, 7A, and 9A

z = (1-a)/2(k) = (1-.95)/2(4) = 0.006; Tabular z = 2.50

P ≤ 0.05

Class 4 & 5 do not exceed np or n(1-p) > 5: p2 close to 0 or 1, therefore classes combined

Land Type	Area	p1 of Area	Observed	Expected	p2 observed	Conf. Int on p2	Comments
Class 1	752	0.557	1,284	1,026.416	0.696	.669<p2<.723	p1 < p2; selected
Class 2	270	0.200	346	368.527	0.188	.165<p2<.211	p1 = p2; no selection
Class 3	142	0.105	113	193.818	0.061	.047<p2<.075	p1 > p2; avoided
Classes 4 & 5	187	0.138	101	255.239	0.055	.042<p2<.068	p1 > p2; avoided
Total	1,351		1,844	1,844.000			

Mixed Land Classifications: Surveys 1A, 4, 5, 9B, 10, 11, 14A, 14B and 14C

z = (1-a)/2(k) = (1-.95)/2(5) = 0.005; Tabular z = 2.57

P ≤ 0.05

Classes 2 & 3 did not exceed np or n(1-p) > 5: p1 close to 0 or 1

When Classes 2 & 3 combined the result was the same - No Selection

Land Type	Area	p1 of Area	Observed	Expected	p2 observed	Conf. Int on p2	Comments
Class 1	225	0.171	113	73.116	0.265	.210<p2<.320	p1 < p2; selected
Class 2	148	0.113	39	48.094	0.091	.055<p2<.127	p1 = p2; no selection
Class 3	143	0.109	40	46.470	0.094	.058<p2<.130	p1 = p2; no selection
Class 4	471	0.358	156	153.057	0.365	.305<p2<.425	p1 = p2; no selection
Class 5	327	0.249	79	106.263	0.185	.137<p2<.233	p1 > p2; avoided
Total	1,314		427	427.000			

Heavily Developed: Surveys 4 and 5, only

z = (1-a)/2(k) = (1-.95)/2(2) = 0.013; Tabular z = 2.24

P ≤ 0.05

Classes 1, 2 & 3 did not exceed np or n(1-p) > 5: p2 close to 0 or 1, therefore combined with Class 4

Only 1 section of Class 1 surveyed and only 22 sections in UMZ

Land Type	Area	p1 of Area	Observed	Expected	p2 observed	Conf. Int on p2	Comments
Classes 1-4	329	0.703	121	106.855	0.796	.723<p2<.869	p1 < p2; selected
Class 5	139	0.297	31	45.145	0.204	.131<p2<.277	p1 > p2; avoided
Total	468		152	152.000			

Appendix VIII. **Occurance (point observations) of antelope in relation to five habitat types. Tested by Bonferroni "z" statistic.**

Class 2 Lands: $z = (1-a)/2(k) = (1-.95)/2(2) = 0.013$; Tabular z = 2.24; $P \leq 0.05$

Land Type	Area	p1 of Area	Observed	Expected	p2 observed	Conf. Int on p1	Comments
NGRS (70%)[a]	683.900	0.700	314.000	268.800	0.818	.774<p2<.862	p1 < p2; selected
CWGR, SRFW & CROP (30%)	293.100	0.300	70.000	115.200	0.182	.138<p2<.226	p1 > p2; avoided
Total	977.000		384.000	384.000			

Class 3 Lands: $z = (1-a)/2(k) = (1-.95)/2(2) = 0.013$; Tabular z = 2.24; $P \leq 0.05$

Land Type	Area	p1 of Area	Observed	Expected	p2 observed	Conf. Int on p1	Comments
NGRS & ISLD (40%)	114.000	0.400	97.000	61.200	0.634	.547<p2<.721	p1 < p2; selected
CWGR, SRFW & CROP (60%)	171.000	0.600	56.000	91.800	0.366	.279<p2<.453	p1 > p2; avoided
Total	285.000		153.000	153.000			

Class 4 Lands: $z = (1-a)/2(k) = (1-.95)/2(2) = 0.013$; Tabular z = 2.24; $P \leq 0.05$

Land Type	Area	p1 of Area	Observed	Expected	p2 observed	Conf. Int on p1	Comments
NGRS & ISLD (16%)	102.600	0.160	108.000	38.895	0.444	.373<p2<.515	p1 < p2; selected
CWGR, SRFW & CROP (84%)	538.400	0.840	135.000	204.105	0.556	.485<p2<.627	p1 > p2; avoided
Total	641.000		243.000	243.000			

Class 5 Lands: $z = (1-a)/2(k) = (1-.95)/2(2) = 0.013$; Tabular z = 2.24; $P \leq 0.05$

Land Type	Area	p1 of Area	Observed	Expected	p2 observed	Conf. Int on p1	Comments
ISLD (<2%)[b]	6.900	0.020	14.000	1.865	0.151	.068<p2<.234	p1 < p2; selected
CWGR, SRFW & CROP (>98%)	337.100	0.980	79.000	91.135	0.849	.766<p2<.932	p1 > p2; avoided
Total	344.000		93.000	93.000			

[a] ( ) Percentage of area based on mid point of land class (eg. Land Class 2: 50-90% native; mid point = 70% native).

[b] ISLD does not exceed np or n(1-p) > 5; p2 close to 0, therefore, results may be questionable.

Appendix IX: **Analysis of group size in each of the five distance bands from the aircraft ($P \leq 0.05$). Band distances from aircraft: A = 50m , B = 100m , C = 200m , D = 400m , E = 800m .**

Analysis of Variance

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio	Probability
Amoung Groups	4	43.98	10.99	3.52	0.007
Within Groups	1,217	3,797.24	3.12		
Adjusted Total	1,221	3,841.22			

Fisher's Least Significant Difference Test

Comparison From	Comparison To	Least Sign. Difference[a]	Difference Between Means[b]	Test Results
Band B	Band A	0.428	0.261	Not Significant
Band C	Band A	0.366	0.122	Not Significant
Band C	Band B	0.383	0.383	Not Significant
Band D	Band A	0.345	0.029	Not Significant
Band D	Band B	0.363	0.290	Not Significant
Band D	Band C	0.287	0.093	Not Significant
Band E	Band A	0.345	0.365	Significant
Band E	Band B	0.363	0.627	Significant
Band E	Band C	0.287	0.244	Not Significant
Band E	Band D	0.260	0.336	Significant

Mean, Error and 95 per cent Confidence Interval Values

Band	Lower Limit	Mean	Upper Limit	Standard Error	Sample Size
A	1.453	1.745	2.037	0.149	141
B	1.170	1.484	1.797	0.160	122
C	1.646	1.866	2.087	0.112	247
D	1.591	1.774	1.957	0.093	358
E	1.926	2.110	2.294	0.094	354

Plot of Treatment Conficence Intervals

[a] The value that the difference has to be larger than in order for the test to be significant at the 95% confidence level.

[b] The actual difference between the two means.

Appendix X: **Analysis of group size when Bands A and B were combined and compared to the three other distance bands (P≤ 0.05). Band distances from aircraft: A and B = 100m , C = 200m , D = 400m , E = 800m .**

Analysis of Variance

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F Ratio	Probability
Amoung Groups	3	38.91	12.97	4.13	0.006
Within Groups	1,218	3,825.03	3.14		
Adjusted Total	1,221	3,863.94			

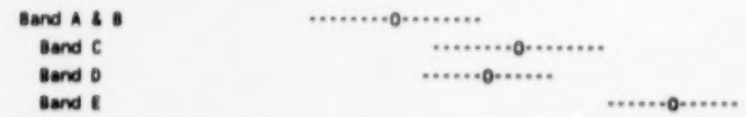
Fisher's Least Significant Difference Test

Comparison From	Comparison To	Least Sign. Difference[a]	Difference Between Means[b]	Test Results
Band C	Band A & B	0.309	0.207	Not Significant
Band D	Band A & B	0.283	0.159	Not Significant
Band D	Band C	0.287	- 0.005	Not Significant
Band E	Band A & B	0.284	0.486	Significant
Band E	Band C	0.288	0.279	Not Significant
Band E	Band D	0.260	0.327	Significant

Mean, Error and 95 per cent Conficence Interval Values

Band	Lower Limit	Mean	Upper Limit	Standard Error	Sample Size
A & B	1.411	1.627	1.843	0.110	260
C	1.613	1.834	2.055	0.113	247
D	1.603	1.786	1.969	0.093	360
E	1.928	2.113	2.297	0.094	355

Plot of Treatment Confidence Intervals



[a] The value that the difference has to be larger than in order for the test to be significant at the 95 per cent confidence level.

[b] The actual difference between the two means.

Appendix XI: Historic herd structure for Saskatchewan pronghorn antelope as collected by aerial surveys, 1949 - 1990.

Year	Yearling Bucks	Mature Bucks	Total Bucks	Does	Kids	Herd Structure Buck: Doe: Kid	Structure Differs From Previous Year (P≤ 0.05)	Population Density Estimate (per km2)
1949[A,b]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1954	N/A	N/A	N/A	N/A	N/A	N/A[c]	N/A	N/A
1957	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.28
1958	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.37
1959	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.29
1960	N/A	N/A	208	362	283	57:100:78	N/A	0.34
1961	N/A	N/A	359	605	470	59:100:78	No	0.32
1962	N/A	N/A	205	215	216	95:100:100	Yes	0.31
1963	N/A	N/A	696	800	859	87:100:107	No	0.44
1964	N/A	N/A	N/A	723	461	N/A:100:64	N/A : Yes[d]	0.35
1965	N/A	N/A	512	968	528	53:100:55	N/A : No[d]	0.21
1966	N/A	N/A	832	1,682	1,424	49:100:85	Yes	0.34
1967	N/A	N/A	678	1,078	882	63:100:82	Yes	0.25
1968	N/A	N/A	902	1,694	1,258	53:100:74	Yes	0.32
1969	N/A	N/A	972	1,658	1,438	59:100:87	Yes	0.34
1970	N/A	N/A	1,188	1,778	1,374	67:100:77	Yes	0.36
1971	N/A	N/A	828	1,706	1,204	48:100:70	Yes	0.31
1972	N/A	N/A	648	1,468	1,036	44:100:71	No	0.17
1973	N/A	N/A	869	2,156	1,368	40:100:63	No	0.20
1974	N/A	N/A	844	1,970	1,082	43:100:55	Yes	0.19
1975	N/A	N/A	462	1,099	692	42:100:63	Yes	0.21
1976	N/A	N/A	498	1,106	896	45:100:81	Yes	0.24
1977	N/A	N/A	459	1,044	668	44:100:64	Yes	0.20
1978	N/A	N/A	424	1,009	697	42:100:69	No	0.20
1979	N/A	N/A	393	820	738	48:100:90	Yes	0.27
1980	N/A	N/A	449	936	758	48:100:81	No	0.30
1981	160	378	538	1,239	841	43:100:68	Yes	0.37
1982	251	429	680	1,721	881	40:100:51	Yes	0.46
1983	117	590	707	1,442	1,120	41:100:78	Yes	0.47
1984	246	685	931	1,607	892	58:100:56	Yes	0.49
1985	95	164	259	571	394	45:100:63	Yes	0.47
1986	53	78	131	221	186	59:100:84	No	0.73
1987	169	287	456	712	686	64:100:96	No	N/A
1988	253	407	660	1,262	826	52:100:65	Yes	0.74
1989	298	532	830	1,469	943	57:100:64	No	0.93
1990	113	192	310	587	360	53:100:61	No	N/A[e]
1960-89 Average	195[f]	416[f]	608	1,171	837	51:100:71		

[a] First aerial antelope survey flown in Saskatchewan.

[b] Aerial surveys flown from 1949 to 1957, inclusive but no data found in archieval literature.

[c] SNR Annual Reports stated higher than normal doe population with ratios being 10 to 11 bucks:100 does, whereas, in other areas the ratio was 100:100.

[d] Buck to doe comparison not available; doe to fawn comparison listed.

[e] Not comparable; survey completed before kid production.

[f] Average from 1981 to 1990, only.

Appendix XII: **Pronghorn antelope harvest statistics as reported by hunters, 1913 - 1990. Years not listed were closed to antelope hunting.**

	Harvest Structure			Total		Harvest Structure			Total
Year	Buck	Doe	Kid	Harvest	Year	Buck	Doe	Kid	Harvest
1913	20	0	0	20	1964	1326	663	297	2286
1936	N/A	N/A	N/A	267	1966	1210	368	472	2050
1937	N/A	N/A	N/A	154	1967	560	203	203	966
1938	N/A	N/A	N/A	219	1968	1565	504	583	2652
1940	N/A	N/A	N/A	226	1969	1306	471	364	2141
1941	N/A	N/A	N/A	395	1970	1697	1143	624	3464
1942	N/A	N/A	N/A	N/A	1971	1796	744	557	3097
1943	N/A	N/A	N/A	N/A	1972	1192	560	681	2433
1944	N/A	N/A	N/A	N/A	1973	1143	784	314	2241
1945	N/A	N/A	N/A	284	1975	746	393	170	1309
1946	N/A	N/A	N/A	N/A	1976	788	483	189	1460
1948	N/A	N/A	N/A	1037	1977	782	433	181	1396
1949	N/A	N/A	N/A	777	1978	822	519	101	1442
1952[a]	881	13	0	1868	1979	1159	724	186	2069
1953[a]	649	85	0	1448	1980	935	601	134	1670
1954	N/A	N/A	N/A	2627	1981	1193	667	113	1973
1955	N/A	N/A	N/A	2035	1982	N/A	N/A	N/A	2109
1956	N/A	N/A	N/A	2354	1983	N/A	N/A	N/A	2065
1957	N/A	N/A	N/A	2208	1984	1206	693	132	2031
1958	N/A	N/A	N/A	3485	1985	1073	550	94	1717
1959	N/A	N/A	255	2548	1986	1672	712	149	2533
1960	1857	833	512	3202	1987	1958	855	137	2950
1961	937	504	360	1801	1988	2586	972	204	3762
1962	1343	592	341	2276	1989	3659	618	130	4407
1963	1728	720	432	2880	1990	3804	1545	216	5567

[a] Buck, only season.

Appendix XIII: Past (1970-89) and simulated (1990-94) population dynamics based on either-sex season, only model.

Bio-Year	Reproduction (No. of Kids)	Preharvest Population	Harvest Statistics: Kids	% Kid Pop.	Bucks	% Buck Pop.	Does	% Doe Pop.	Total Harvest	Percent of Population Harvested	Postharvest Population	Ratio (Buck:100 Doe:Kid)	Percent of Growth in Population
1970	4,366	14,203	624	14.3%	1,697	41.0%	1,143	20.0%	3,464	24.4%	10,444	52:100:83	- 9.8%
1971	3,801	12,273	557	14.7%	1,796	59.7%	744	13.6%	3,097	25.2%	8,921	23:100:69	-11.4%
1972	3,803	11,388	681	17.9%	1,192	54.1%	560	10.4%	2,433	21.4%	8,747	20:100:64	- 4.4%
1973	3,411	10,885	314	9.2%	1,143	56.0%	784	14.4%	2,241	20.6%	8,454	18:100:67	- 9.0%
1974	2,852	9,904	0	0.0%	0	0.0%	0	0.0%	0	0.0%	9,904	36:100:55	24.1%
1975	3,650	11,950	170	4.7%	746	29.6%	393	6.8%	1,309	11.0%	10,532	32:100:65	11.4%
1976	4,834	13,645	189	3.9%	788	27.9%	483	8.1%	1,460	10.7%	12,063	36:100:85	3.1%
1977	4,119	13,746	161	4.4%	782	24.3%	433	6.8%	1,396	10.2%	12,234	40:100:66	6.3%
1978	4,618	14,501	101	2.2%	822	25.5%	519	7.8%	1,442	9.9%	12,939	38:100:74	10.9%
1979	6,078	16,520	186	3.1%	1,159	31.5%	724	10.7%	2,069	12.5%	14,279	41:100:99	4.9%
1980	5,805	16,841	134	2.3%	935	24.2%	601	8.4%	1,670	9.9%	15,032	44:100:87	2.9%
1981	5,261	16,342	113	2.1%	1,193	36.1%	667	8.6%	1,973	12.1%	14,208	29:100:73	- 9.9%
1982	4,133	15,772	176	4.3%	1,207	34.6%	729	8.9%	2,112	13.4%	13,485	30:100:54	10.8%
1983	6,273	17,928	173	2.8%	1,181	32.7%	714	8.9%	2,068	11.5%	15,688	32:100:84	0.8%
1984	4,862	18,063	132	2.7%	1,206	26.6%	693	8.0%	2,031	11.2%	15,865	41:100:60	7.0%
1985	5,544	18,879	94	1.7%	1,073	23.9%	550	6.2%	1,717	9.1%	17,023	41:100:66	16.6%
1986	7,886	22,548	149	1.9%	1,672	31.6%	712	7.6%	2,533	11.2%	19,812	41:100:90	17.9%
1987	9,939	26,587	137	1.4%	1,958	31.2%	855	8.2%	2,950	11.1%	23,400	44:100:104	2.9%
1988	7,718	26,545	204	2.6%	2,586	37.3%	972	8.2%	3,762	14.2%	22,484	39:100:69	- 0.2%
1989	7,975	27,274	130	1.6%	3,659	53.3%	618	5.0%	4,407	16.2%	22,536	25:100:67	- 0.3%
1990[a]	8,142	27,213	416	5.1%	2,957	51.2%	1,247	9.4%	4,620	17.0%	22,220	22:100:65	- 5.3%
1991[a]	6,959	25,763	416	6.0%	2,957	54.7%	1,247	9.3%	4,620	17.9%	20,770	19:100:54	- 5.4%
1992[a]	6,719	24,387	416	6.2%	2,957	65.0%	1,247	9.5%	4,620	18.9%	19,394	12:100:53	- 1.4%
1993[a]	7,577	24,054	416	5.5%	2,957	81.5%	1,247	9.7%	4,620	19.2%	19,061	4:100:62	- 4.2%
1994[b]	7,298	23,048	416	5.7%	2,826	93.5%	1,247	9.8%	4,489	19.5%	18,330	1:100:60	- 2.3%

[a] Harvest based on check station harvest ratios and either sex licence quota of 5,600 licences.

[b] Licence quota reduced to 5,400 licence due to over harvest of bucks.

Simulated (1990-96) population dynamics based on either-sex and non-trophy seasons, only model. Population objective of 15,000 antelope postharvest at ratio 25 bucks: 100 does: 80 kids reached in 1994.

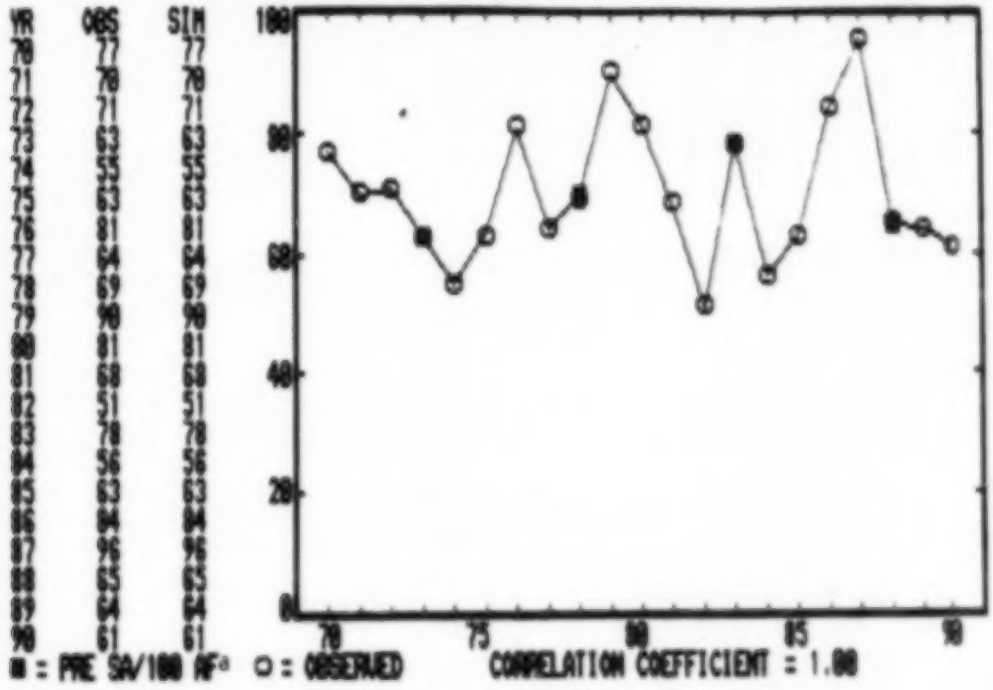
			Harvest Statistics										
Bio-Year	Reproduction (No. of Kids)	Preharvest Population	Kids	% Kid Pop.	Bucks	% Buck Pop.	Does	% Doe Pop.	Total Harvest	Percent of Population Harvested	Postharvest Population	Ratio (Buck:100 Doe:Kid)	Percent of Growth in Population
1989	7,975	27,274	130	1.6%	3,659	53.3%	618	5.0%	4,407	16.2%	22,536	25:100:67	- 0.3%
1990	8,142	27,213	305	3.7%	3,882	67.2%	1,464	11.0%	5,651	20.8%	21,113	14:100:67	- 9.9%
1991	6,819	24,470	0	0.0%	1,470	33.2%	3,075	23.3%	4,545	18.6%	19,514	29:100:69	- 0.4%
1992	7,814	24,349	1,090	13.9%	2,585	49.1%	2,116	18.8%	5,791	23.8%	18,057	28:100:74	- 7.8%
1993	7,154	22,446	805	11.3%	2,558	52.7%	2,087	20.0%	5,450	24.3%	16,528	26:100:77	- 9.6%
1994	6,444	20,297	536	8.3%	2,355	54.2%	1,988	20.9%	4,879	24.0%	15,000	25:100:80	- 9.1%

Simulated (1990-96) population dynamics based on either-sex and non-trophy seasons, only model. Population objective of 15,000 antelope postharvest at ratio 25 bucks: 100 does: 80 kids reached in 1992 and maintained until 1994.

			Harvest Statistics										
Bio-Year	Reproduction (No. of Kids)	Preharvest Population	Kids	% Kid Pop.	Bucks	% Buck Pop.	Does	% Doe Pop.	Total Harvest	Percent of Population Harvested	Postharvest Population	Ratio (Buck:100 Doe:Kid)	Percent of Growth in Population
1989	7,975	27,274	130	1.6%	3,659	53.3%	618	5.0%	4,407	16.2%	22,536	25:100:67	- 0.3%
1990	8,142	27,213	1,741	21.4%	2,074	35.9%	1,837	13.8%	5,652	20.8%	21,058	32:100:55	- 9.2%
1991	6,580	24,651	3,739	56.8%	2,074	36.1%	4,090	33.2%	9,903	40.2%	13,820	45:100:32	-24.9%
1992*	6,210	18,524	324	5.2%	2,339	54.0%	605	7.6%	3,268	17.6%	15,000	25:100:80	- 0.7%
1993*	5,830	18,398	0	0.0%	1,946	49.8%	1,219	14.1%	3,165	17.2%	14,976	25:100:80	- 0.9%
1994*	5,757	18,223	0	0.0%	1,935	49.6%	1,136	13.3%	3,071	16.9%	14,903	25:100:79	0.6%

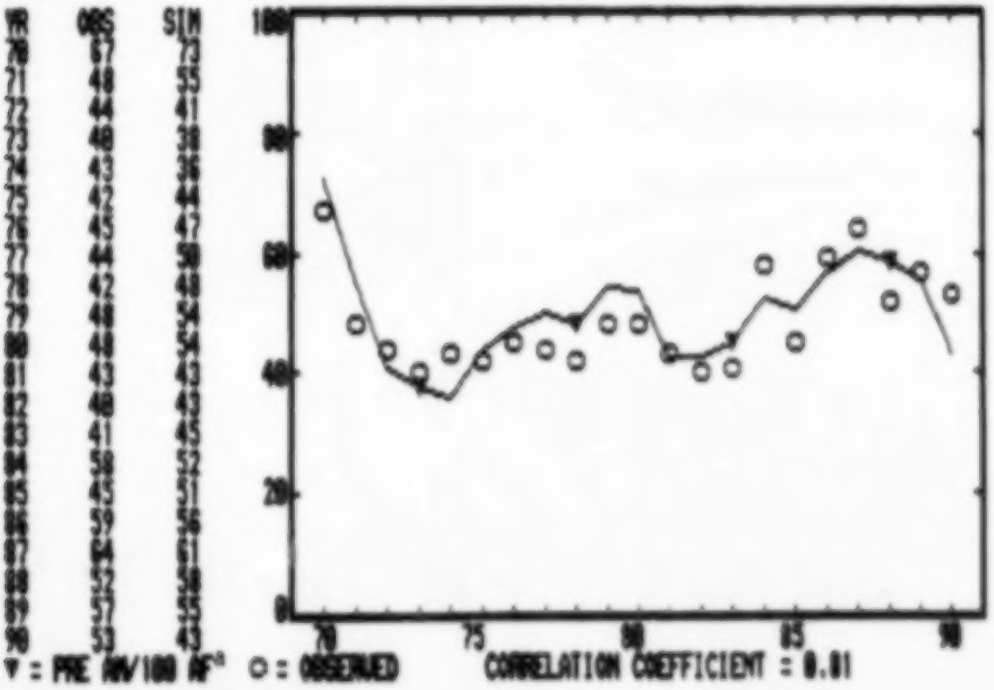
* Some of the harvest statistics were unrealistic and unobtainable. In order to maintain the desired population objectives few or no kids can be harvested from 1992 onward. This is to allow for recruitment and high harvest levels the following year. As kids will no doubt be harvested, future seasons will have to account for this loss in recruitment.

Correlation of observed (July aerial surveys) to simulated (aligned model) kid to doe ratios in the preseason.

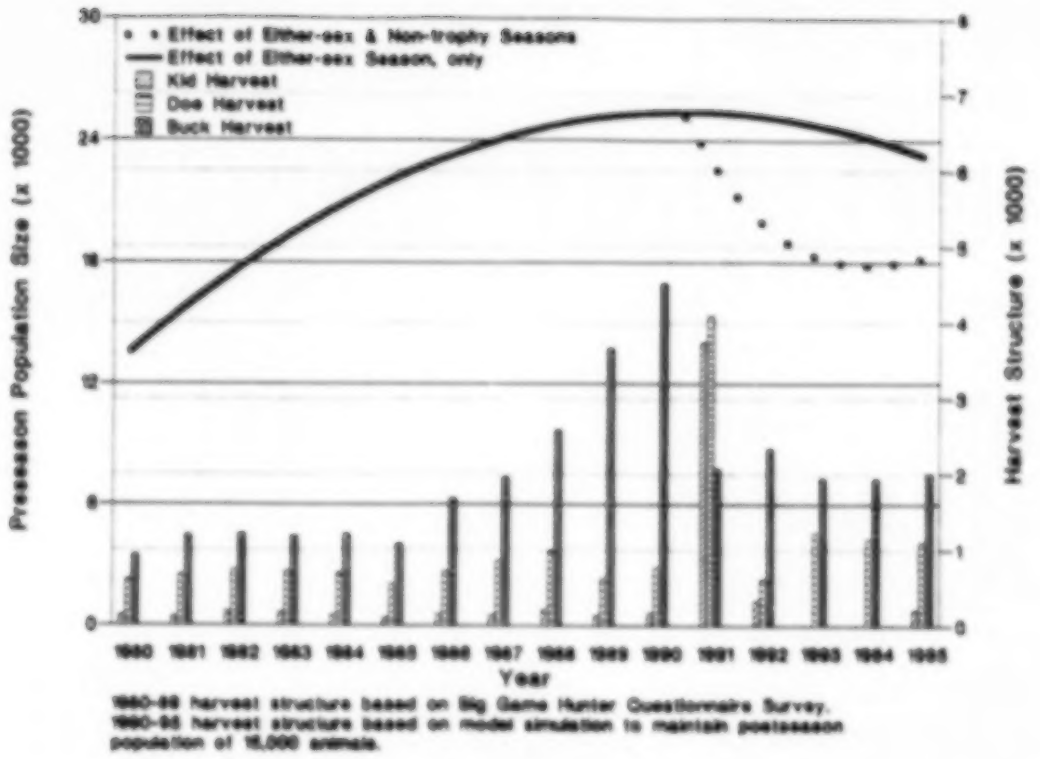


[a] Preseason subadults (kids) to 100 adult females.

Correlation of observed (July aerial surveys) to simulated (aligned model) buck to doe ratios in the preseason.



[a] Preseason adult males to 100 adult females.



1980-89 harvest structure based on Big Game Hunter Questionnaire Survey.
1990-95 harvest structure based on model simulation to maintain postseason population of 18,000 animals.

Effects of two different hunting strategies on antelope population size and harvest structure in Saskatchewan. Preseason population trend and harvest structure.

Appendix XIV: Licence allocations, eligible and successful applicants by priority pool for the 1988-90 Big Game Draw.

Year	Species	Licences Available (Issued)	Super A Applicants	Successful Super A Applicants	Pool A Applicants	Successful Pool A Applicants	Pool B Applicants	Successful Pool B Applicants	Pool C Applicants	Successful Pool C Applicants	Total Eligible Applicants	Number of Super A Pool Applicants in 1989[a]
1988	Elk	1,100 (1,120)	3,269	1,120 (34%)[b]	3,637	0	563	0	483	0	7,952 (14%)	5,786
	Moose	2,150 (2,217)	1,415	1,084 (77%)	3,260	1,104 (34%)	850	18 (2%)	770	11 (1%)	6,295 (35%)	2,543
	Mule Deer	6,000 (6,162)	644 (100%)	644	5,076	4,271	4,412	1,009	2,744	238	11,876	805
	Antlerless Mule Deer	2,250 (2,093)	0	0	1,652	1,617 (98%)	288	279 (97%)	660	197 (30%)	2,600 (81%)	35
	Antelope	4,550 (4,346)	64	64 (100%)	2,615	2,589 (99%)	1,172	1,034 (88%)	1,279	659 (52%)	5,130 (85%)	26
Total		16,050 (15,938)	5,392	2,912	16,240	9,581	6,285	2,340	5,936	1,105	33,853	9,195
1989	Elk	1,250 (1,260)	3,702	1,238 (33%)[b]	4,265	22 (1%)	738	0	481	0	9,186 (14%)	N/A
	Moose	1,875 (1,883)	1,417	925 (65%)	3,656	958 (26%)	1,029	0	845	0	6,947 (27%)	N/A
	Mule Deer	6,400 (6,428)	648	648 (100%)	6,703	5,069 (76%)	4,383	622 (14%)	3,054	89 (3%)	14,788 (43%)	N/A
	Antlerless Mule Deer	5,025 (3,424)	39	31 (79%)	2,189	1,784 (81%)	939	636 (68%)	1,296	973 (75%)	4,463 (77%)	N/A
	Antelope	5,000 (5,014)	64	64 (100%)	2,662	2,611 (97%)	1,445	1,292 (89%)	2,282	1,047 (46%)	6,453 (78%)	N/A
Total		19,550 (18,009)	5,870	2,906	19,475	10,444	8,534	2,550	7,958	2,109	41,837	N/A
1990	Elk	1,745 (1,764)	4,180	1,647 (39%)[b]	3,927	118 (3%)	623	0	560	0	9,290 (19%)	6,343
	Moose	2,075 (2,086)	1,892	1,320 (70%)	3,487	749 (21%)	1,116	17 (2%)	845	0	7,237 (29%)	3,310
	Mule Deer	6,525 (6,591)	1,108	1,099 (99%)	6,422	4,885 (76%)	3,062	538 (18%)	2,132	21 (1%)	12,724 (52%)	1,546
	Antlerless Mule Deer	6,325 (6,294)	2,834	2,826 (99%)	1,902	1,741 (92%)	404	392 (97%)	1,482	1,245 (84%)	6,622 (94%)	169
	Antelope	6,400 (6,426)	334	334 (100%)	2,418	2,390 (99%)	1,924	1,799 (94%)	2,908	1,903 (65%)	7,584 (85%)	28
Total		23,070 (23,071)	10,348	7,225	18,156	9,883	7,129	2,746	7,824	3,169	43,457	11,396

[a] Assumes all unsuccessful Super A and Pool A applicants will apply in the Draw the following year.

[b] Per cent of successful applicants.

Appendix XV: Expenditures by archery and rifle antelope hunters.

	1989 Either-sex Season of 5,341 Licences		
	Expenditures	Provincial Output	Employment
Transportation	$326,008.00	$440,306.00	7.0
Accommodation	$71,876.00	$112,220.00	1.8
Food	$164,288.00	$268,709.00	2.0
Equipment	$506,981.00	$776,695.00	9.6
Other	$214,344.00	$328,375.00	4.1
Total	$1,283,497.00	$1,926,305.00	24.5

	1991 Non-trophy Season of 5,000 Licences		
	Expenditures	Provincial Output	Employment
Transportation	$305,360.00	$412,419.00	6.5
Accommodation	$67,323.00	$105,111.00	1.7
Food	$153,882.00	$251,689.00	1.9
Equipment	$474,871.00	$727,502.00	9.0
Other	$200,768.00	$307,577.00	3.8
Total	$1,202,204.00	$1,804,298.00	22.9

Appendix XVI: Introductory letter, questionnaire format and percentage of response per question for a survey sent to 590 Saskatchewan pronghorn antelope hunters. Respondents totalled 289 hunters.

July 10, 1990

Dear Hunter:

The pronghorn antelope population has been on the increase over the past few years and wildlife managers now believe that the population is the highest recorded since the late 1800's. The record number of antelope demands that new and enhanced management techniques be implemented in order to balance population numbers relative to the herd structure. A larger population will cause more depredation for landowners on whose land we depend upon for access to manage our wildlife resources. Higher antelope numbers also present greater hunting opportunities for the Saskatchewan hunter.

Saskatchewan Parks and Renewable Resources is undertaking a review of pronghorn antelope management and our licensing system. An important aspect being considered is the introduction of a non-trophy antelope season. A non-trophy animal is defined as "**A female or male pronghorn antelope having horns not more than 7.6 cm (3 inches) in length**".

As a past antelope hunter we would like your opinion on non-trophy antelope hunting and the type of season structure you might prefer. We are asking for your co-operation by completing the attached questionnaire and returning it to us **no later than August 11, 1990.** A postage-paid return envelope is enclosed for your convenience.

Thank you for your anticipated co-operation in Saskatchewan's pronghorn antelope management program.

Sincerely,

Dennis Sherratt
Director of Wildlife

WILDLIFE BRANCH ---- HUNTER QUESTIONNAIRE

1. Would you participate in a non-trophy antelope hunt?

Yes [83%] No [17%]

2. If yes, please rate <u>each</u> of the following factors as to how important they would be in influencing your decision as to whether you would participate in a non-trophy antelope hunt. Circle either IMPORTANT, LITTLE IMPORTANCE or NOT IMPORTANT.

(a) Availability Of The Licence

• (over the counter sales)

IMPORTANT - 64% LITTLE IMPORTANCE - 17% NOT IMPORTANT - 19%

• (distributed through the big game draw)

IMPORTANT - 35% LITTLE IMPORTANCE - 26% NOT IMPORTANT - 39%

(b) Increased Bag Limit

• (opportunity to harvest more than one non-trophy antelope)

IMPORTANT - 45% LITTLE IMPORTANCE - 25% NOT IMPORTANT - 30%

(c) Increased Involvement Of Young Hunters

• (person under 16 may hunt non-trophy antelope)

IMPORTANT - 50% LITTLE IMPORTANCE - 19% NOT IMPORTANT - 31%

(d) Dates Of The Season

• (non-trophy season during the either-sex season)

IMPORTANT - 60% LITTLE IMPORTANCE - 18% NOT IMPORTANT - 22%

• (non-trophy season after the either-sex season)

IMPORTANT - 33% LITTLE IMPORTANCE - 29% NOT IMPORTANT - 39%

(e) Combination Species Licence

• (may harvest an antlerless mule deer at the same time)

IMPORTANT - 76% LITTLE IMPORTANCE - 11% NOT IMPORTANT 14%

(f) Licence Fee In Comparison To Either Sex Licence

Same Price - 24% Reduced Price - 65% Doesn't Matter - 12%

If "Reduced Price" what do you suggest the fee for a non-trophy antelope licence should be $<u>average = $18.96</u> .

$0.00 - 4.99 = 3%	$20.00 - 24.99 = 40%
5.00 - 9.99 = 2%	25.00 - 29.99 = 24%
10.00 - 14.99 = 10%	30.00 - 34.99 = 5%
15.00 - 19.99 = 17%	

3. Based on our experience with antlerless mule deer seasons and the experience of other North American jurisdictions with non-trophy antelope seasons, the following options appear viable season structures for Saskatchewan. Which season option would you prefer? Please check only <u>one</u> option.

[28%] A separate non-trophy antelope season which starts one week after the start of the regular either-sex season. Successful applicants for the regular either-sex draw would not be eligible to hold a non-trophy antelope licence (one licence per hunter per year). This option is identical to the present system used in allocating regular and antlerless mule deer licences.

- that is, non-trophy season delayed 1 week; either-sex licence holders cannot hold a non-trophy licence.

[23%] Treat non-trophy antelope as a totally separate species and allow all hunters (including successful regular either-sex antelope applicants) the opportunity to purchase a non-trophy licence. Regular either-sex antelope hunters would be allowed to hunt for their non-trophy animal in the same season dates as for their regular licence. Antelope hunters who possess just a non-trophy licence, and not a regular antelope licence, would have their season start one week following the regular either-sex antelope season.

- that is, non-trophy season delayed 1 week; either-sex licence holders can hold a non-trophy licence.

[42%] Treat non-trophy antelope as a totally separate species and allow all hunters (including successful regular either-sex antelope applicants) the opportunity to purchase a non-trophy licence. Season dates for regular either-sex antelope and non-trophy antelope would be the same, that is, a complete overlap. Regular either-sex licence holders would not have a week by themselves before the start of the non-trophy season.

- that is, non-trophy season dates the same as either-sex season dates; either-sex licence holders can hold a non-trophy licence.

[7%] Other: (your suggestions) _____

_____

_____

_____

_____

Appendix XVII: Number of depredation claims that received payment and total amount paid-out by wildlife management zone, 1983 to 1990[a].

	1983-84		1985-86		1986-87		1987-88		1988-89		1989-90		1990-91		TOTAL	
WMZ	Claims	Pay-out	Claims	Pay-out	Claims	Pay-out	Claims	Pay-out	Claims	Pay-out	Claims	Pay-out	Claims	Pay-out	Claims	Pay-out
1									1	$269					1	$269
2					1	$675	2	$2,713	5	$1,686			10	$9,759	18	$14,833
4							1	$340	1	$720	1	$1,345			3	$2,405
5					2	$1,140	1	$100	2	$3,091	1	$1,750	1	$144	7	$6,205
6							1	$100	2	$782			2	$1,280	5	$2,082
7							1	$120							1	$120
8											1	$541			1	$541
9									1	$1,474					1	$1,474
10			1	$2,350			1	$550	4	$2,749			3	$2,846	9	$8,495
11													1	$362	1	$362
13	1	$2,480	3	$1,687	4	$2,832	1	$325	3	$2,737			9	$10,741	21	$20,642
14			1	$400			1	$462					3	$3,212	5	$4,074
24							1	$400							1	$400
25							3	$2,295	1	$2,500			5	$3,697	9	$8,492
26			1	$331					1	$665			4	$5,492	6	$6,488
27									1	$235					1	$235
31	1	$210													1	$210
45							2	$3,100			1	$750	1	$200	4	$4,050
unk.									2	$1,447			1	$196	3	$1,643
Total	2	$2,690	6	$4,688	7	$4,647	15	$10,505	24	$18,275	4	$4,366	40	$37,929	98	$83,020

[a] Some damage claims were the result of both antelope and deer combined and could not be separated by species.